A DESCRIPTIVE STUDY OF THE SPECTRA OF THE A-TYPE STARS

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By
WILLIAM W. MORGAN

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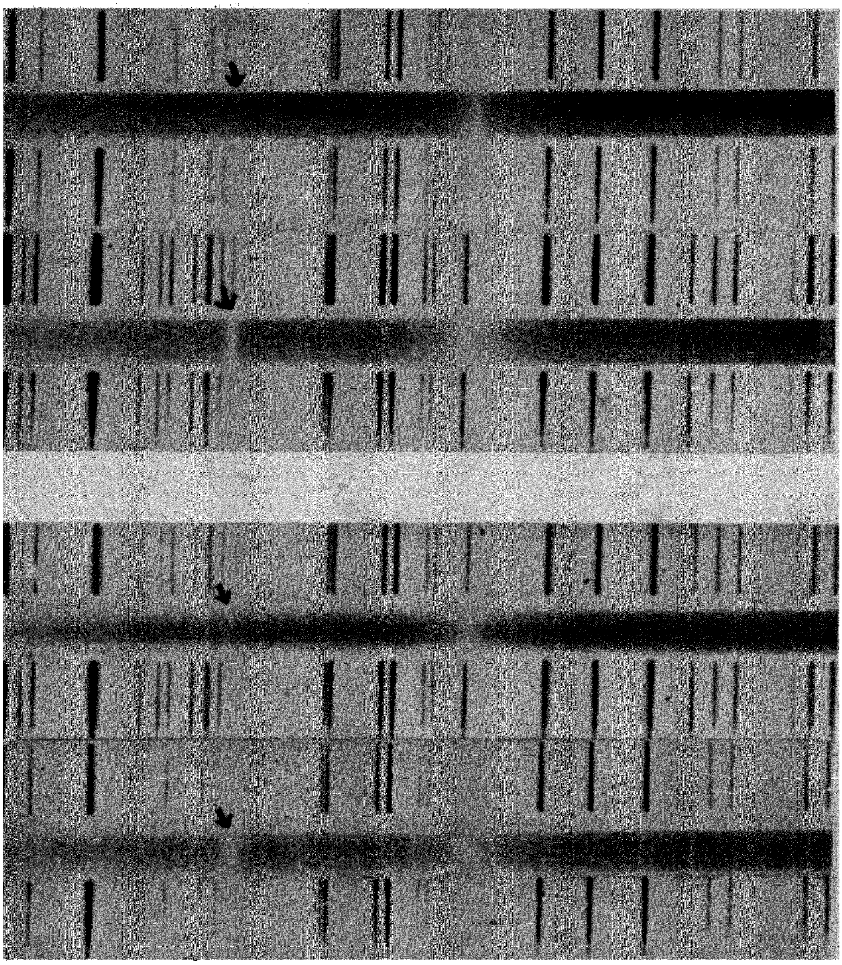

SPECTRA OF (*a*) 41 TAURI (A0), (*b*) γ GEMINORUM (A0), (*c*) 78 VIRGINIS (A2p), (*d*) μ ORIONIS (A2), SHOWING RANGE IN INTENSITY OF *Ca* II K WITHIN INDIVIDUAL SPECTRAL SUBDIVISIONS.

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By W. W. Morgan

1. There is probably a greater diversity in appearance among the spectra of class A than in any other type. It is well known that lines of singly ionized calcium, europium, manganese, chromium, silicon, and strontium show considerable differences in intensity between certain stars. Many of the most striking dissimilarities cannot be explained by differences in temperature or surface gravity in the stellar atmospheres and form at the present time one of the most puzzling problems in astrophysics. The observational material for most of the peculiarities is quite scanty, while for not one star can it be said to be completely satisfactory; even in the case of such much-observed objects as Algol and β Lyrae there are fields of investigation which have hardly been touched upon. It is the purpose of the present paper to give as complete a description of A-type spectra as can be made from plates of moderate dispersion. The study will be divided into the following sections: (I) a general survey of the behavior of the most abundant elements; (II) a detailed description of the spectra of thirteen type stars.

I. A GENERAL SURVEY OF THE A-TYPE SPECTRA

2. If the A stars of some subdivision, for example A0, are examined, a remarkable diversity in the appearance of the spectra is apparent. This diversity has been known since the time of Sir Norman Lockyer, and subsequent investigations have tended toward complicating the problem through the discovery of additional peculiarities. At Harvard a considerable number of spectra were found in which the lines of *Si* II and *Sr* II are exceptionally strong; the identification of peculiar lines in α Andromedae and α Canum Venaticorum with ionized manganese and europium was made by Baxandall; at Mount Wilson spectra were observed in which lines of *Y* II and *Cr* II are outstanding; Edwards has observed a number of spectra in which the K line of *Ca* II is abnormally weak. Additional examples of these peculiarities have been recorded at Yerkes. The variability in intensity of the lines in a number of these stars has also been established.

It is apparent that a one-dimensional system of classification cannot be satisfactory in the case of such a complex group of spectra. Former investigations have indicated that the A-type stars will not fit even into a two-dimensional scheme. Instead of limiting the number of available dimensions to those physically interpretable, an attempt will be made to describe the behavior of each of the more important elements with respect to each of the others. This method of treatment was first suggested by Struve and was applied by him to the B-type stars.[1]

3. As no limitation is to be placed on the number of empirical variables which may appear, any observed quantity which changes among the spectra could be used for arranging the stars in a primary one-dimensional system. It is convenient, however, to exercise a certain selection. As the stars to be considered have already been limited to those in the Henry Draper spectral range B8–F0 it is of some advantage to have a fundamental dimension which roughly parallels the Harvard sequence and which does not pass through a maximum in the range considered. It should be noted that such a selection limits in no way the generality of the discussion as all other variations will appear later.

The use of ratios of intensity of two lines is unsatisfactory because of the uncertainty of not knowing how much each line contributes to a change in the line ratio. For this reason, in spite of

[1] *Ap. J.*, **78**, 73, 1933.

the fact that intensity ratios can probably be estimated more accurately than individual line intensities, it is preferable to investigate the behavior of the intensity of individual lines. The fundamental dimension will, therefore, be the intensity of a single line. The line should not pass through a maximum and should show a considerable difference in intensity in the range B8–F0. Practical considerations suggest that the line should be strong enough to be observable in all of the stars considered and that it should be sensibly unblended.

There are two lines which satisfy these conditions: *Ca* II K and *Fe* I 4045. The K line shows a greater range in intensity among the A stars than does any other; its one disadvantage is that it is rather far toward the violet for convenient observation on some series of slit spectrograms. *Fe* I 4045 is just observable at B8–B9 and increases in intensity fairly uniformly to F0. Its disadvantages are that its range in intensity is much less than K and that it is too weak to be observable in some B8 and B9 stars. In spite of its inconvenient location, K is probably the most suitable line. There is the further advantage in its use that it is one of the principal standards for spectral type in the Henry Draper system.

4. The observational material consists of all of the stars observed at Yerkes between types B8 and F0 for which good spectrograms are available. Spectra in which the absorption lines are sensibly broadened on plates of one-prism dispersion were omitted because of the difficulty of making estimates of line intensity which are consistent with those from narrow line stars. The subdivisions B8 and F0 are not complete; the B8 stars are included in Struve's paper, while the F0 spectra are being investigated by Hynek. The number of stars used is about one hundred and thirty. Almost all of these are brighter than magnitude 5.5; a few fainter objects of special interest have also been included. Most of the plates were obtained on the general radial velocity programs of the B and A stars at Yerkes and the others were taken for various special investigations during the last five years. All of the spectra used in the present section are of one-prism dispersion and have a scale of 30 A per millimeter at λ 4500.

As some of the spectra were taken as long as thirty years ago, the emulsions and treatment of the plates in development have been widely different. This introduces the principal source of uncertainty in the estimates of the line intensities. On the Eastman 40 plates used for the basis of the estimates the lines are slightly weaker systematically than on the early Seed 27 and Seed 30 plates. A fairly accurate measure of this systematic difference was made from spectra of the same star obtained on different emulsions and the difference was then allowed for.

5. The intensity of *Ca* II K was estimated for all of the stars on an arbitrary scale which was adjusted so that a difference of one unit is apparent to the eye but is still a comparatively small amount. On plates of good quality of the same star the intensity estimates of K rarely differ by as much as one unit; it is possible that for a few stars for which only poor spectrograms were available the uncertainty may be as much as two units, but the mean deviation of a determination of the intensity of K is considerably less than one unit. It is very improbable that any star is in a group more than two units from its correct place. Table I gives the stars in the order of intensity of K, which ranges from an intensity of 2 to 16. As the intensity 16 refers to the F5 star Procyon, which was included for purposes of comparison, there are in reality fourteen groups within the spectral limits included. No effort has been made to arrange the objects in each group in the order of intensity of K; any such differences are small and are of the same order as errors due to the difference in quality of the spectrograms. The columns in Table I give: (1) a serial number; (2) the name of the star; (3) the H.D. spectral type; (4) the intensities of *Ca* II K, *Fe* I 4045, *Si* II 4131, *Sr* II 4215, *Fe* II 4233, $H\gamma$, *He* I 4471, *Mg* II 4481, *Ti* II 4501, *Fe* II 4508, and *Cr* II 4558. The intensity of λ 4233 is not given in the stars where *Fe* I is strong because *Fe* II becomes blended with a strong line due to *Fe* I. An *c* placed immediately before the name of the star denotes a *c*-star. Intensities placed within brackets denote that the line is variable in intensity.

TABLE I

ESTIMATED INTENSITIES OF LINES IN 125 STARS

No.	Star	H.D. Spec.	*Ca* II K	*Fe* I 4045	*Si* II 4131	*Sr* II 4215	*Fe* II 4233	*He* I 4471	*Mg* II 4481	*Ti* II 4501	*Fe* II 4508	*Cr* II 4558
1.....	ι Lib	A0p	2	1	5	1	1	1	2	1	1	1
2.....	41 Tau	A0p	2	1	5	1	3	1	2	1	1	1
3.....	θ Aur	A0p	2	1	6	1	4	0?	4	1	1	2
4.....	β Per	B8	2	1	2	0	1	2	4	1:	1	1
5.....	α And	A0p	2	0	2	1	1	1	2	1:	1	1
6.....	α^2 C Vn	A0p	[3]	1:	4	1	[3]	1:	2	1	1	1
7.....	τ^9 Eri	A0p	3	1	8	[1]	4	2	4	1	1	1
8.....	BS 1643	A0p	3	1	7	1	3	1	2	1	1	1
9.....	36 Lyn	B8	3	0	1	1	1	1	3	1	1	1
10.....	ω Cas	B8	3	0	2	0	1	1	2	0	1	0
11.....	22 Eri	B8	3	0	3	1:	1	1	2	0	0	0
12.....	ρ Her(br)	A0	3	1	1	1:	1	1	3	1	1	1
13.....	β Tau	B8	3	1:	2	0	1	2	2	2	1	1
14.....	ω Her	A0p	4	2	1:	2	4	0	4	1	1	2
15.....	φ Sgr	B8	4	1:	2	1:	1	2	5	0	1:	1:
16.....	11 Ori	B9	4	1	2	1	2	1	2	1	1	1
17.....	84 U Ma	A0p	4	1	1	2	4	[1]	4	1	1	3
18.....	γ Ari (S)	A0p	4	2	2bl.	2	3	0	3	1	1	2
19.....	20 Tau	B5	4	1:	1	0	1	1	1	0	1:	1:
20.....	30°3223 Lyr	B8	4	1:	1	0	1	1	4	1	0	1
21.....	ι And	B8	4	1	2	0	1	1	2	1	1	0
22.....	47°847 Per	B8	4	1:	3	0	1:	1	2	0	0	0
23.....	33°3154 Lyr	B8	4	0	2	1	1	1	2	1	0	1
24.....	17 Com	A0p	5	2	1	[4]	[4]	0	4	1	1	3
25.....	21 Aql	B8	5	1:	3	1	2	3	4	0	1	1
26.....	ο Aur	A0	5	3	1:	1	4	0	3	2	1	1
27.....	21 Per	A0p	5	[1–4]	5	3	2	0	2	2	1	2
28.....	14 Cyg	B8	5	1:	2	0	2	1	3	0	0	1
29.....	π Boo	A0	5	0	3	1	2	1	4	0	0	1
30.....	14 Hya	B9	5	0	3	0	2	1	3	1	1	1
31.....	γ Lyr	A0p	5	0	1	0	1	1	3	0	0	0
32.....	κ Cnc	B8	5	1:	3	1	2	1	3	0	1	1
33.....	μ Lep	A0p	5	1	3	1	2	1	3	1:	1:	1
34.....	γ Crv	B8	5	1	1	0	1	1	2	1	1:	1:
35.....	56 Tau	A0p	6	1	8	1	3	1	2	1	1	1
36.....	φ Her	B9p	6	1	2	1	2	1	5	1	1	1
37.....	78 Vir	A2p	6	4	1	6	6	0	5	1	1	3
38.....	73 Dra	A2p	6	5	1	10	[6]	0	6	[4]	1	5
39.....	13 Vul	A0	6	1	1	1:	2	1	3	1	1	1
40.....	46 Dra	A0	6	1	2	1	1	1	3	1	1	1
41.....	υ Her	B9	6	1:	2	1	1	1	3	1	1	0
42.....	108 Vir	B9	6	1	1	0	1	1	2	0	0	0
43.....	α Scl	B5	6	1	2	1	2	2	2	1	0	1
44.....	σ Psc	A2	6	1	1	1	2	1	3	1	1	0
45.....	45 Her	A0p	7	1	2	1	4	0	4	1	1	2
46.....	BS 1035	B9p	7	1:	5	0	5	4	8	1:	1	1
47.....	BS 1732	A0p	7	1	8	1	[3]	[1]	[3–6]	1	1	1
48.....	ε U Ma	A0p	[7]	1	1	......	3	0	......	1	1	......
49.....	49 Cnc	A0p	7	2	6	3	4	1	4	2	1	2
50.....	52 Her	A2p	7	3	1	7	3	0	3	1	1	2
51.....	BS 5355	A0p	7:	5	1	Var	Var	0	Var	1	1	......
52.....	4 Lac	B8p	7	1:	5	0	3	2	5	0	1	0

TABLE I—*Continued*

No.	Star	H.D. Spec.	*Ca* II K	*Fe* I 4045	*Si* II 4131	*Sr* II 4215	*Fe* II 4233	*He* I 4471	*Mg* II 4481	*Ti* II 4501	*Fe* II 4508	*Cr* II 4558
53	53 Tau	B8	8	1	3	1	1	1	4	1	1	1
54	29 Vul	A0	8	1	2	1:	2	1	3	1	1	0
55	134 Tau	B9	8	1	4	0	3	1	5	1	1	1:
56	ν Cap	A0	8	2	2	0	1	0	4	1	1	1
57	μ Lib	A2p	8	2	1	7	4	0	5	1	1	3
58	κ Psc	A2p	8	3	1:	4	5	0	5	2	2	3
59	BS 3082	A0	8	2	3	1	3	1	4	1	1	1
60	κ Cep	B9	9	3	3	2	4	1:	5	1	1	1
61	α C Ma	A0	9	3	2	2	3	0	4	1	1	1
o62	σ Cyg	A0p	9	1	4	0	5	2	5	0	2	2
63	α Dra	A0p	9	1	1	1	1	1	3	1:	1:	1
64	14 Cr B	A0	9	1	2	1	2	0	4	1	1	0
65	θ Aql	A0	9	1	2	1:	2	1	4	1	1	1
o66	η Leo	A0p	9	1	3	0	5	1	6	1	1	1
67	ν Cnc	A0	9	1	2	2	2	1	4	1	1	1
68	BS 4072	A0	9	2	2	2	3	1	4	1	1	1
69	21 Lyn	A0	9	2	2	1:	2	1:	4	1	1:	1:
o70	13 Mon	A0p	9	2	4	0	5	1	5	1	2	1
o71	13 Cep	B9p	10	0	4	0	1	5	5	0	1:	1:
72	47 Boo	A0	10	1	1	0	1	1	4	1	1	1
73	15 Sex	A0	10:	3	1	1	1	0	5	1	1	1
74	α Lyr	A0	10	2	1	1:	2	0	5	1	1	1
o75	β Ori	B8p	10	0	4	0	2	5	6	1:	1	1:
o76	BS 1040	A0p	10	1:	6	0	4	2	7	1	2	1:
77	136 Tau	A0	10	1	1	1:	2	1	4	1	1	1
o78	3 Pup	A2p	10	3	5	1	8	0	5	2	3	2
79	21 Oph	A0	10	2	2	1	1	1	4	1	1	1
80	o Peg	A0	10	3	2	2	3	0	6	2	1	1
81	θ Vir	A0	10	3	2	2	2	0	5	1	1	1
82	14 Peg	A0	11	1	2	1	2	1	6	1	1	0
83	β U Ma	A0	11	2	2	1	3	1:	4	1	1	1
84	ω U Ma	A0	11	2	2	1	3	1:	4	1	1	1
o85	α Cyg	A2p	11	2	4	1:	8	1:	7	2	4	3
86	α Gem(br)	A0	11	3	2	2	3	0	4	2	1	1
87	η Oph	A2	11	4	2	3	4	0	4	2	1	1
o88	υ Sgr	B8p, F2p	11	1	8	2	7	4	8	1	3	3
89	7 Vir	A0	11	1	1	1	1	0	4	1	1	1
o90	μ Sgr	B8p	11	0	3	1	1	0	6	0	1	1:
[91	ι Cas	A5p	[11–15]	3	1	9	3	0	4	2	1	[3]]
92	θ Leo	A0	11	3	1	2	3	0	5	2	1	1
93	2 U Ma	A0	12	7	2	6	......	......	5	2	2	2
94	γ Gem	A0	12	2	2	1	3	......	5	1	1	1
95	α Gem (ft)	A	12	5	2	3	......	......	4	2	2	2
96	η Vir	A0	12	4	3	2	......	......	4	1	1	1
97	60 Leo	A0	12	5	3	5	5	......	6	1	2	2
98	ζ U Ma (seq)	A2p	12	6	1	4	......	......	6	2	1	2
99	16 Ori	A2	12	8	2	6	......	......	4	2	2	2
100	ε Ser	A2	12	6	1	5	......	......	6	2	2	2
101	47 Her	A0	12	5	1:	3	......	......	5	1	2	2
102	21 Com	A3p	13	3	1:	[6–10]	3	......	6	1	1	2
103	59 Her	A2	13	4	2	3	4	......	6	2	2	2
104	υ Oph	A2	13	5	1:	2	......	......	5	1	1	1

TABLE I—*Continued*

No.	Star	H.D. Spec.	*Ca* II K	*Fe* I 4045	*Si* II 4131	*Sr* II 4215	*Fe* II 4233	*He* I 4471	*Mg* II 4481	*Ti* II 4501	*Fe* II 4508	*Cr* II 4558
105.....	BS 5887	A2	13	8	2	5	......	......	5	2	2	2
106.....	15 U Ma	A3p	13	9	2	7	......	......	4	3	2	2
107.....	55 U Ma	A2	13	3	1	2	3	......	4	1:	1:	1
108.....	95 Leo	A2	13	5	2	4	3	......	3	1	1	1
109.....	ψ Sco	A2	13	5	2:	5	......	......	5	2	2	1
110.....	BS 6455	A2	13	5	3	5	......	......	6	2	2	1
111.....	μ Ori	A2	13	5	2	4	......	......	5	2	2	2
112.....	BS 5762	A2	13	7	2	5	......	......	5	2	2	2
113.....	π Dra	A2	13	4	1	3	......	......	5	2	2	2
114.....	19 Aur	A5p	14	4	3	4	5	......	6	3	3	3
115.....	101 Her	A3	14	7	1	4	......	......	6	3	3	2
116.....	2 Hya	A5	14	6	2	4	......	......	6	2	2	2
117.....	ζ Lyr	A3	14	8	2	7	......	......	5	2	2	2
118.....	δ Del	A5	14	9	1	6	......	......	3	2	2	2
119.....	β Cr B	F0p	14	6	1	[3–6]	......	......	3	2	1	2
120.....	μ Cet	F0	15	6	1:	5	......	......	5	2	2	2
121.....	40 Aur	A3	15	9	1	7	......	......	4	2	2	2
122.....	22 Boo	A5	15	9	1	7	......	......	4	3	2	3
123.....	ξ Ser	A5	15	9	2	7	......	......	5	2	2	1
o124....	ϵ Aur	F5p	15	9	2	8	......	......	8	7	7	6
125.....	Procyon	F5	16	10	1	6	......	......	4	2	2	1

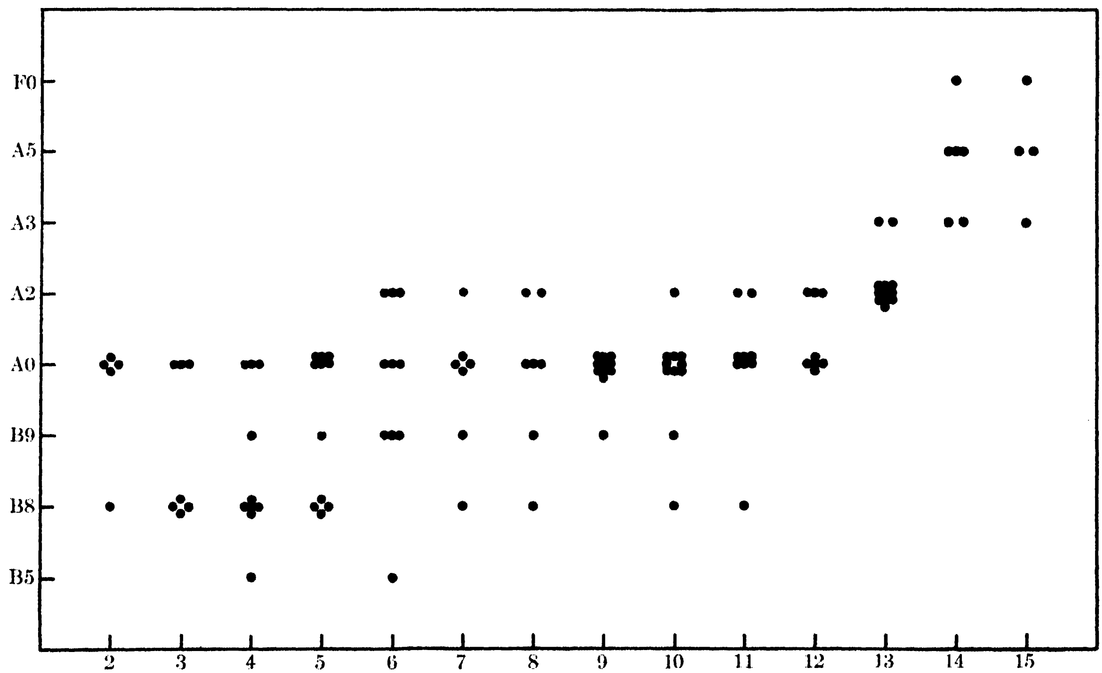

FIG. 1.—Intensity of K plotted against H.D. spectral types

The intensities of K are plotted against Henry Draper spectral types in Figure 1. The scatter is large, especially for classes A0 and A2. An idea of the difference in intensity which K may have in a spectral subclass can be obtained from Plate I, which shows pairs of stars of the same spectral

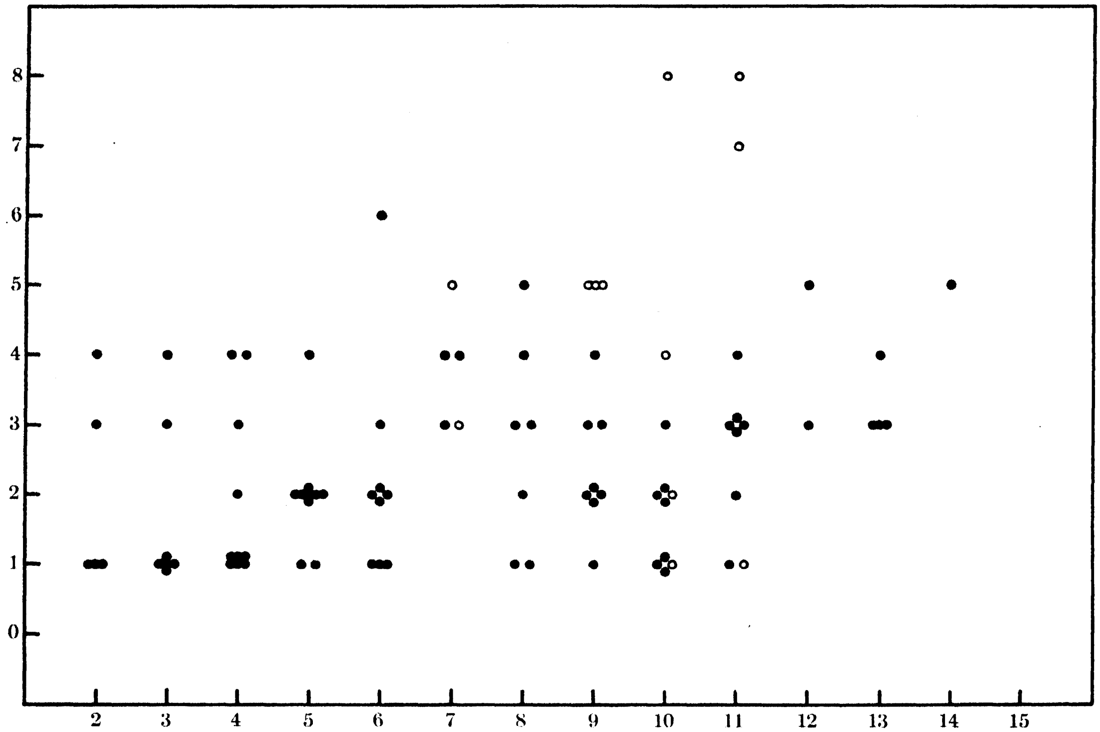

FIG. 2.—Intensities of K, abscissas, and *Fe* II 4233, ordinates. Open circles are c-stars

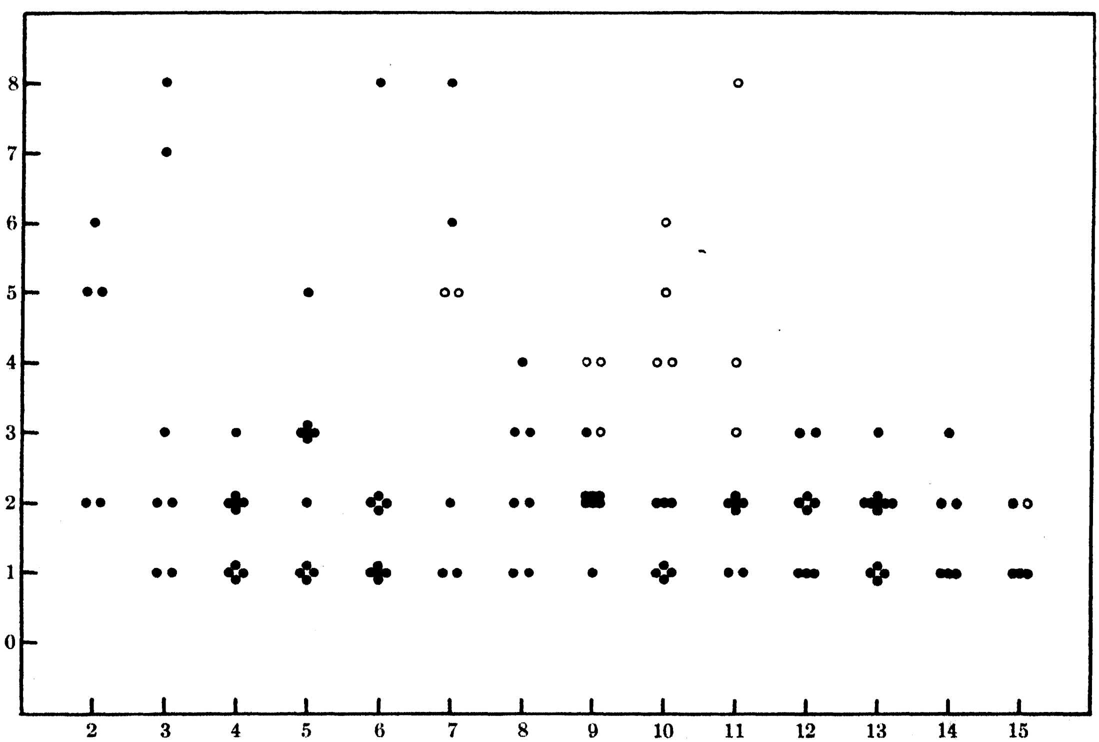

FIG. 3.—Intensities of K, abscissas, and *Si* II 4131, ordinates. Open circles are c-stars

types but having greatly different intensities for K. The K line is considerably weaker in the A2 stars 78 Virginis and 73 Draconis than in such A0 stars as γ Geminorum, Sirius, and Vega.

6. Figures 2–6 give the intensities, taken from Table I, of some of the more important elements as a function of the intensity of K. The "c"-stars are shown by open circles. *Fe* II 4233 (Fig. 2) is systematically stronger in the supergiants than in the other stars; the two "c"-stars having weak 4233 are the B8 supergiants β Orionis and μ Sagittarii. The abnormal strength of the K line causes these stars to be placed in a group where the general excitation is considerably lower. The intensity of 4233 is not a clear function of absolute magnitude as the line is as strong in such peculiar dwarfs as 78 Virginis and κ Piscium as it is in most of the supergiants.

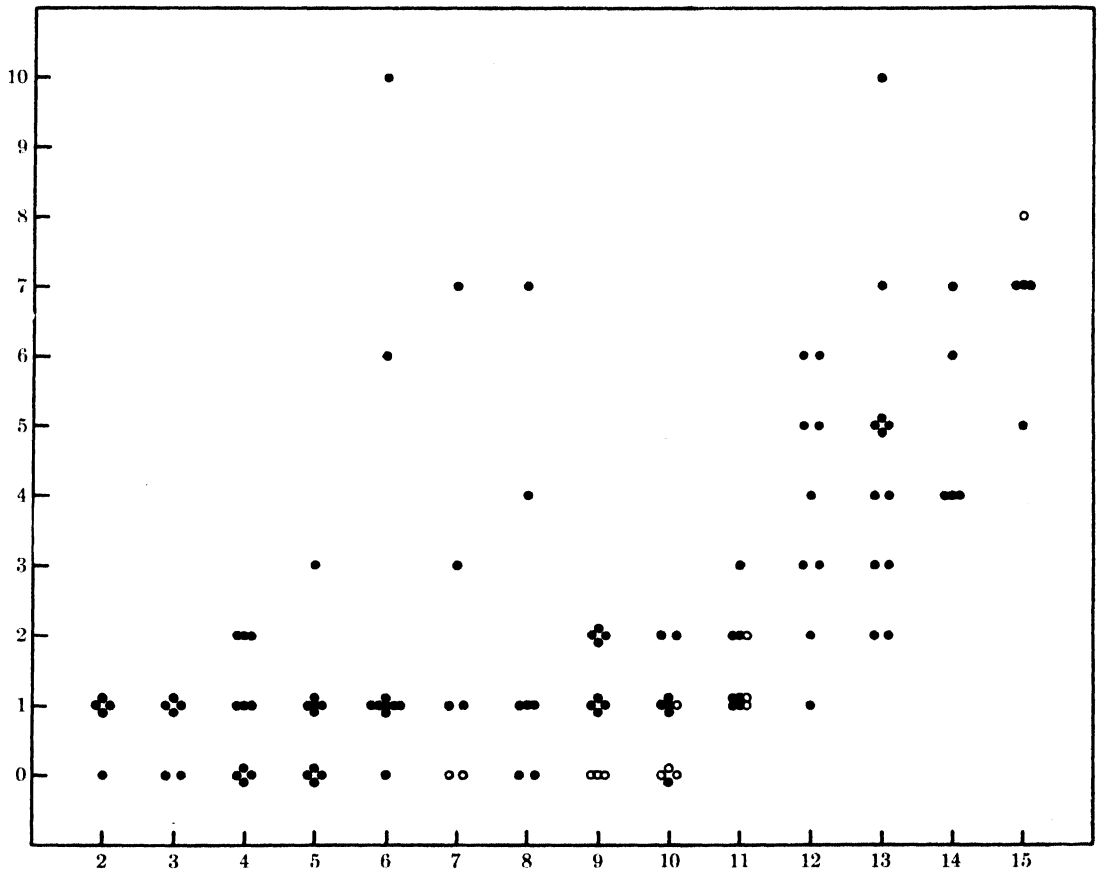

FIG. 4.—Intensities of K, abscissas, and *Sr* II 4215, ordinates. Open circles are c-stars

Si II 4131 (Fig. 3) shows an even greater range in intensity among stars having K of the same intensity. The line is strengthened in the "c"-stars over the normal dwarfs but reaches its greatest strength in the "silicon" stars. Previous investigations have placed these peculiar stars in a separate group which is generally considered to be discrete from the ordinary B9 and A0 dwarfs. There seems to be no well-defined line of demarcation which separates the silicon stars from other dwarfs; the intensity of *Si* II differs considerably among members of the so-called normal dwarfs and also among members of the silicon group. This rather uniform scatter is shown in Figure 3. If the spectra in which K has an intensity of 2 and 3 are considered, we find among the ordinary dwarfs two stars (36 Lyncis and ρ Herculis [br]) having an intensity of 1 for λ 4131, two stars (β Persei and ω Cassiopeiae) having an intensity of 2, one star (22 Eridani) having an intensity of 3, one (α^2 Canum

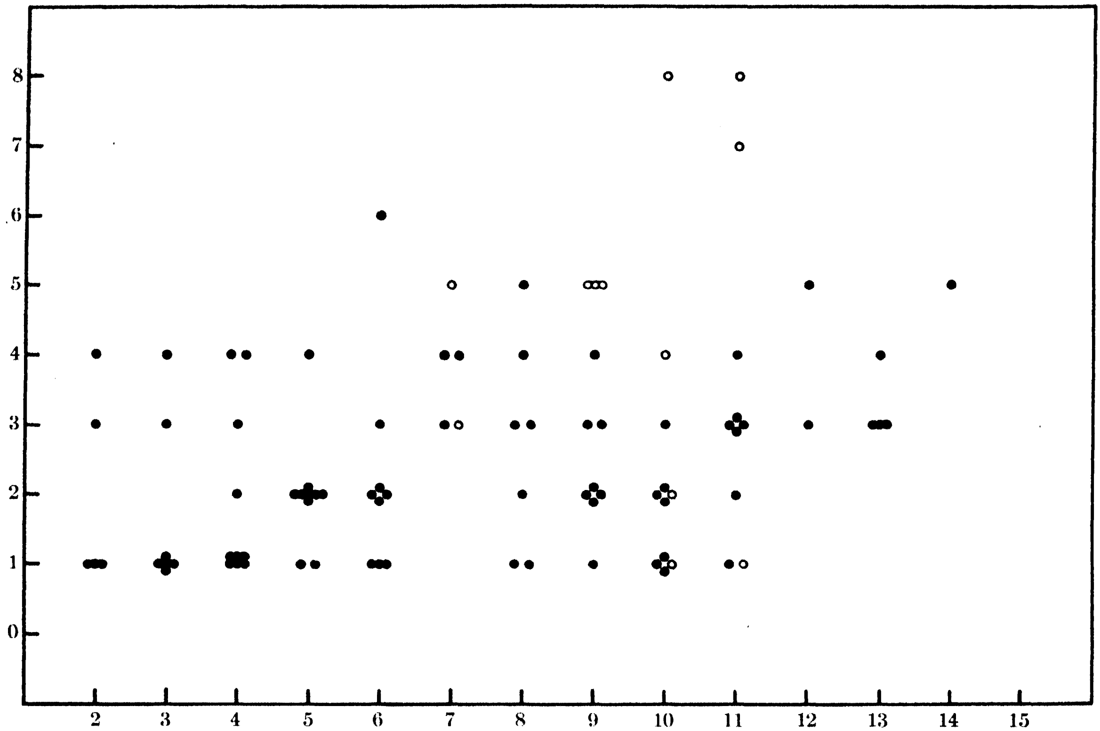

FIG. 2.—Intensities of K, abscissas, and *Fe* II 4233, ordinates. Open circles are c-stars

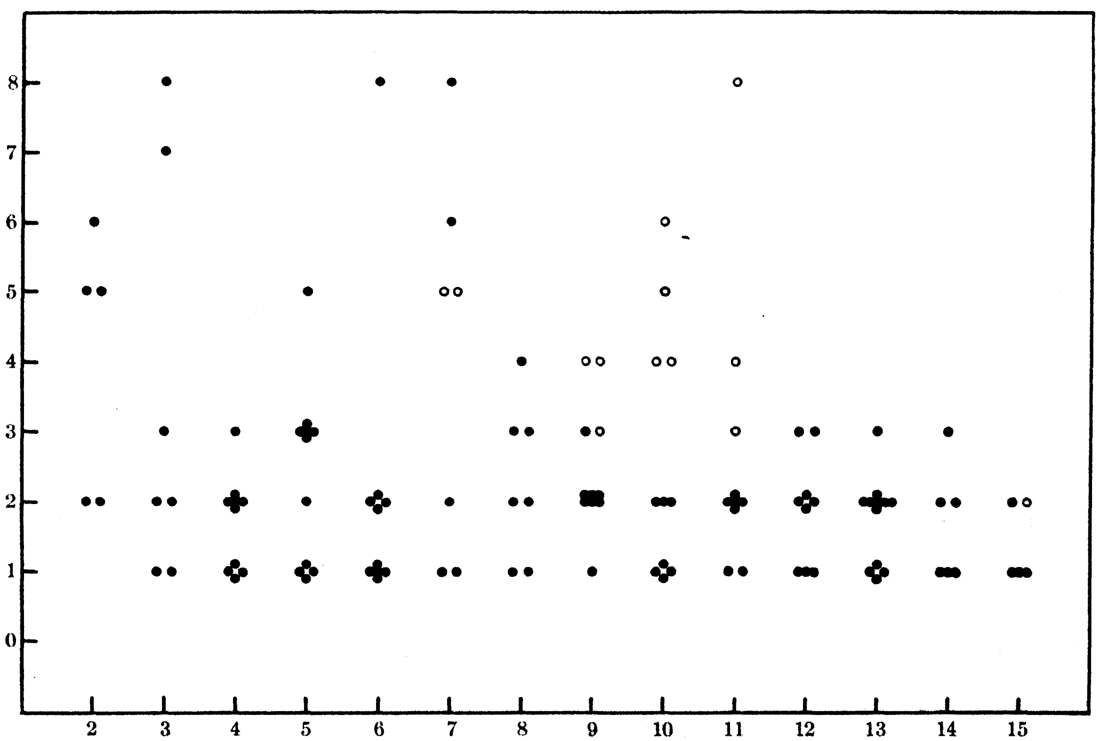

FIG. 3.—Intensities of K, abscissas, and *Si* II 4131, ordinates. Open circles are c-stars

types but having greatly different intensities for K. The K line is considerably weaker in the A2 stars 78 Virginis and 73 Draconis than in such A0 stars as γ Geminorum, Sirius, and Vega.

6. Figures 2–6 give the intensities, taken from Table I, of some of the more important elements as a function of the intensity of K. The "c"-stars are shown by open circles. *Fe* II 4233 (Fig. 2) is systematically stronger in the supergiants than in the other stars; the two "c"-stars having weak 4233 are the B8 supergiants β Orionis and μ Sagittarii. The abnormal strength of the K line causes these stars to be placed in a group where the general excitation is considerably lower. The intensity of 4233 is not a clear function of absolute magnitude as the line is as strong in such peculiar dwarfs as 78 Virginis and κ Piscium as it is in most of the supergiants.

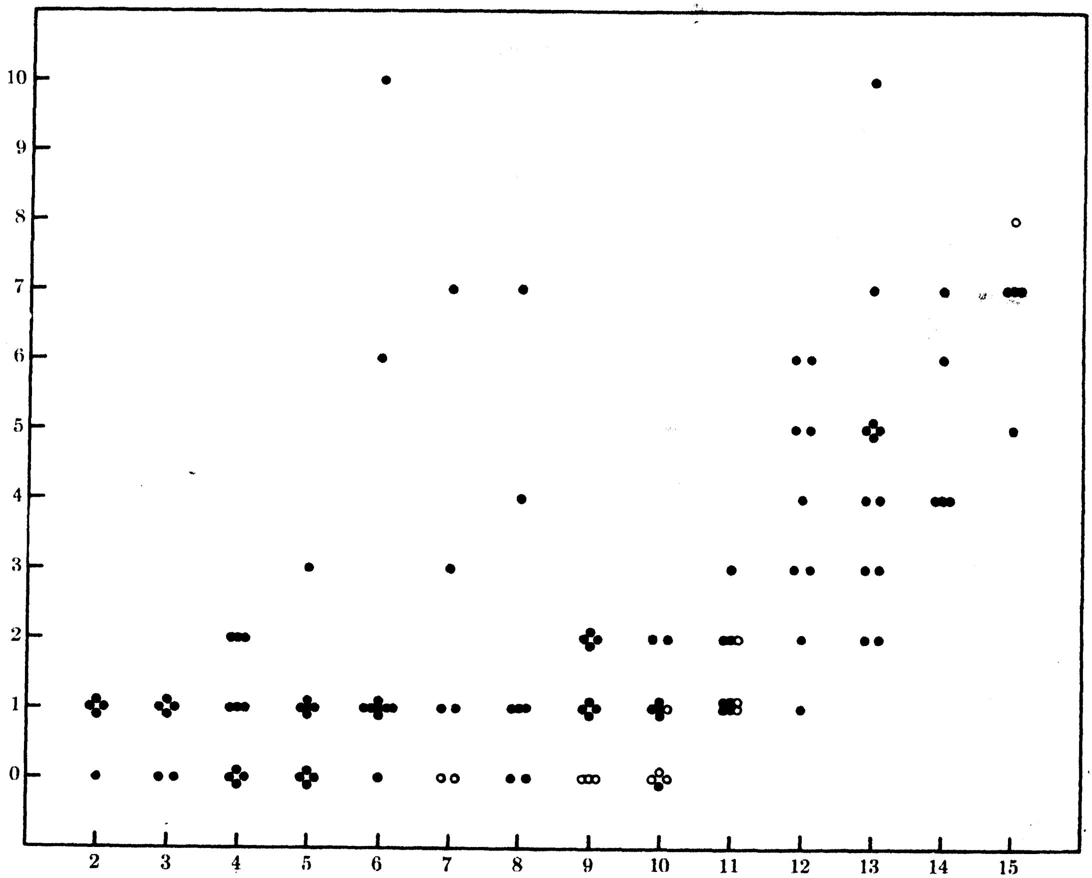

FIG. 4.—Intensities of K, abscissas, and *Sr* II 4215, ordinates. Open circles are c-stars

Si II 4131 (Fig. 3) shows an even greater range in intensity among stars having K of the same intensity. The line is strengthened in the "c"-stars over the normal dwarfs but reaches its greatest strength in the "silicon" stars. Previous investigations have placed these peculiar stars in a separate group which is generally considered to be discrete from the ordinary B9 and A0 dwarfs. There seems to be no well-defined line of demarcation which separates the silicon stars from other dwarfs; the intensity of *Si* II differs considerably among members of the so-called normal dwarfs and also among members of the silicon group. This rather uniform scatter is shown in Figure 3. If the spectra in which K has an intensity of 2 and 3 are considered, we find among the ordinary dwarfs two stars (36 Lyncis and ρ Herculis [br]) having an intensity of 1 for λ 4131, two stars (β Persei and ω Cassiopeiae) having an intensity of 2, one star (22 Eridani) having an intensity of 3, one (α^2 Canum

Venaticorum) of intensity 4, two (ι Librae and 41 Tauri) of intensity 5, one (θ Aurigae) of intensity 6, one (BS 1643) of intensity 7, and one (τ^9 Eridani) of intensity 8. It seems, therefore, that the "silicon" stars are extreme examples of the large difference in intensity *Si* II may have among stars of approximately the same spectral type; the present evidence suggests that they probably do not form a discrete group.

The behavior of *Sr* II 4215 is shown in Figure 4. The line is very weak or absent in the A-type supergiants. Most of the peculiar "strontium" stars occur between intensities 4 and 8 for K. In only two cases among the stars included in Table I are abnormally strong silicon and strontium found in the same spectrum; *Si* II is strong in 49 Cancri and 21 Persei, while *Sr* II is also rather

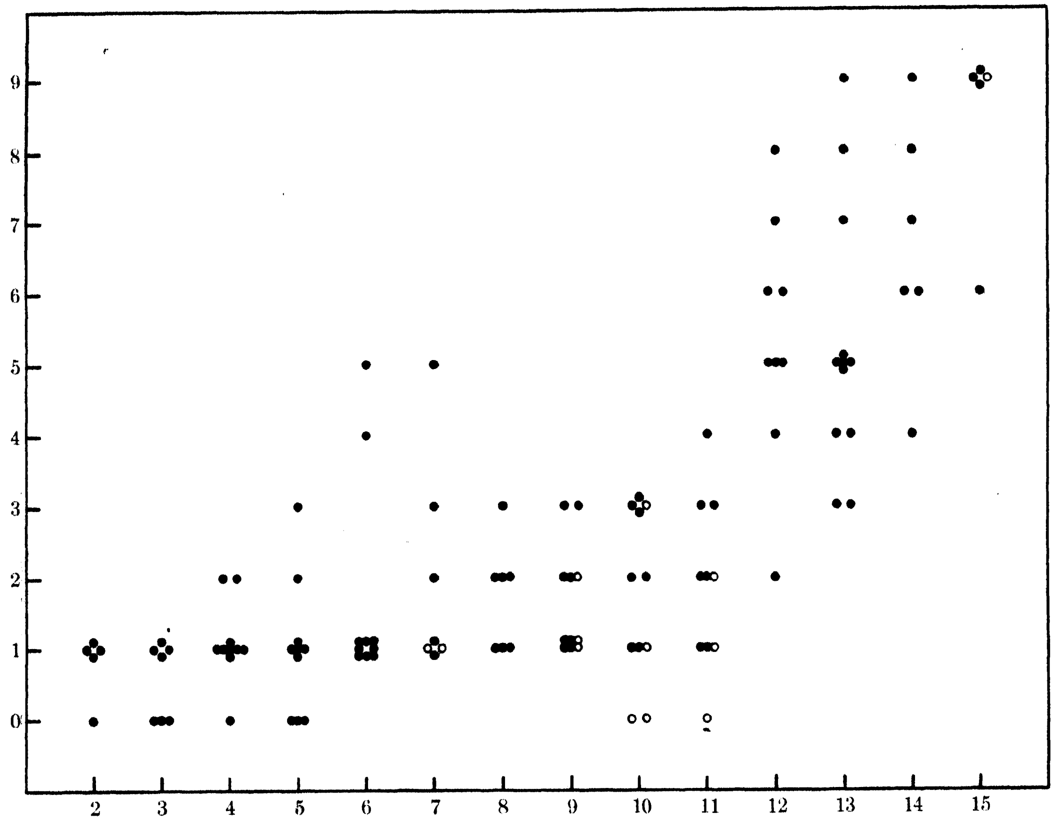

FIG. 5.—Intensities of K, abscissas, and *Fe* I 4045, ordinates. Open circles are c-stars

strong, although λ 4215 is considerably weaker than in such stars as 73 Draconis and 52 Herculis. The behavior of *Sr* II is similar to that of *Si* II in that the range in intensity is large for a given intensity of K; there also seems to be no discrete grouping of the "strontium" stars with respect to the ordinary dwarfs. If the intensity of *Sr* II 4215 in the range of intensity K=4 to K=8 is considered we find: fourteen stars in which the line is absent or doubtfully present (these include the only two supergiants in the interval); twenty in which 4215 is of intensity 1; three (ω Herculis, 84 Ursae Majoris, and γ Arietis [s]) of intensity 2; two (21 Persei and 49 Cancri) of intensity 3; two (17 Comae and κ Piscium) of intensity 4; one (78 Virginis) of intensity 6; two (52 Herculis and μ Librae) of intensity 7; and one (73 Draconis) of intensity 10. In 73 Draconis the line varies in intensity. The distribution is very smooth when the comparatively small number of stars included is taken into consideration.

The other peculiar A-type stars show similar characteristics. The lines of *Mn* II, *Cr* II, *Eu* II, and the unidentified λ 4200 are intrinsically weaker than the *Si* II and *Sr* II lines, but all show the same scatter in intensity for stars having identical intensities for K. In not a single case do the spectra seem to fall into a separate group distinct from the normal stars. There are always as many transitional examples as there are cases in which the peculiarities are unusually strong.

The behavior of *Fe* I 4045 is shown in Figure 5. Again there is a large vertical scatter in the intensities. At K = 6, for example, λ 4045 is doubtfully present in β Tauri and κ Cancri while it is a strong line in 73 Draconis and 78 Virginis. The scatter is similar to that for *Si* II and *Sr* II, except that the amplitude is in general somewhat less. The intensity of λ 4045 is practically independent of the intensity of K over the range K = 5 to K = 12.

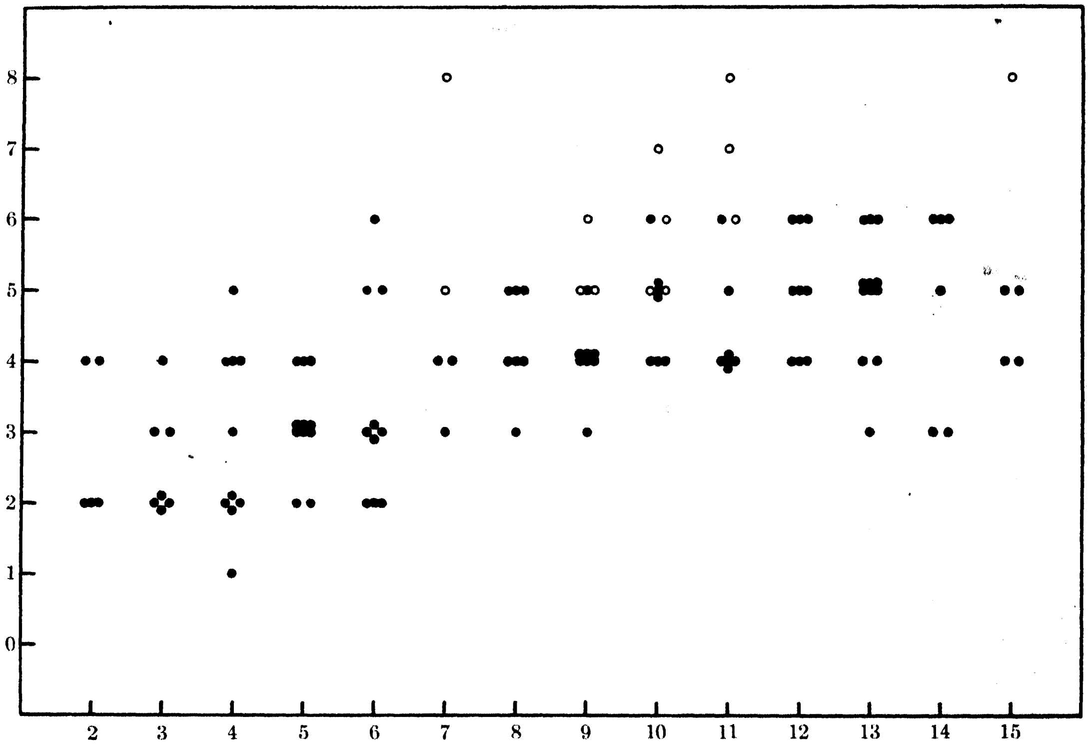

FIG. 6.—Intensities of K, abscissas, and *Mg* II 4481, ordinates. Open circles are c-stars

Figure 6 gives the intensities of *Mg* II 4481. In this case there is definite evidence that the line is strengthened in supergiants as compared with the other stars; there are, however, a number of dwarfs, both normal and peculiar, in which λ 4481 is as strong as in many of the "c"-stars. The same marked vertical dispersion is present as was found for the other elements investigated. The difference in intensity of λ 4481 shown by two stars having equal intensity for K and possessing similar dwarf characteristics is shown in a comparison of φ Sagittarii and 20 Tauri.

7. The failure of the one-dimensional system to define uniquely the position of an A-type spectrum is apparent. Even after the tacit introduction of a second dimension in the comparison of the dwarfs with the "c"-stars, discrepancies are still numerous. The problem will now be limited additionally by the examination of spectra which are located in the same position in a two-dimensional diagram. The primary dimension will still be the intensity of *Ca* II K while the intensity of *Fe* II 4233 will be taken for the second co-ordinate. Any other of the elements which have been discussed could have been used; the selection is entirely one of convenience.

If we refer again to Figure 2, we see that there are several places on the diagram where a number of stars fall at the same position. If the stars could be made to fit a two-dimensional scheme, all of the spectra lying at a common point should be identical. An investigation of how closely spectra located at the same position resemble one another will give an indication of the number of dimensions it would be necessary to have in the classification scheme to give a unique position to every kind of spectrum observed. Several of these points at which a number of spectra are located will be examined.

a) **K = 2; 4233 = 1; ι Lib, α And, β Per.**—All of the stronger *He* I lines are present in Algol. They are weaker in α Andromedae and in ι Librae. *Mg* II 4481 is considerably stronger in Algol than in the other stars. *Si* II is weak in Algol, is slightly stronger in α Andromedae, and is very strong in ι Librae. The *Mn* II lines which distinguish the spectrum of α Andromedae are absent from Algol and are so faint as to be only doubtfully present in ι Librae. The unknown line at λ 4200 is very strong in ι Librae, weak in α Andromedae, and probably not present in Algol. ι Librae is a member of the "silicon" group. From the greatly different appearance of these three spectra it is apparent that no two dimensions can represent the observed peculiarities.

b) **K = 3; 4233 = 1; 36 Lyn, ω Cas, 22 Eri, ρ Her.**—With the exception of the *Si* II doublet, which is somewhat stronger in 22 Eridani than in the other stars, the spectra are similar within the errors of the plates.

c) **K = 4; 4233 = 1; φ Sgr, 20 Tau, BS 6968, ι And, BS 1063, BS 6997.**—There are marked anomalies in this group. *Mg* II is very strong in φ Sagittarii and very weak in 20 Tauri; its intensity is intermediate in the other stars. *Si* II is considerably stronger in BS 1063 than in 20 Tauri. The peculiar *Mn* II lines are strong in BS 6997; the two strongest lines are doubtfully present in BS 6968, while they are completely absent from the other stars.

d) **K = 5; 4233 = 2; 21 Aql, 21 Per, π Boo (br) 14 Hya, μ Lep, κ Cnc.**—Each of these stars has peculiarities which have been noted in former investigations. π Bootis, 14 Hydrae, μ Leporis, and κ Cancri belong to the group of "manganese" stars. All four stars have *Si* II lines of moderately strong intensity with *Mg* II 4481 of about the same strength in each spectrum; the lines due to *Mn* II are outstanding in all and the spectra are similar in other respects. The other two members of the group are, however, very different. 21 Aquilae has helium lines which vary both in intensity and in degree of sharpness; its spectrum is typical of a B8 dwarf if the line variations are not considered. *Si* II and *Mg* II have about the same intensity as in the four *Mn* II stars, but there is no trace of the numerous manganese lines which distinguish the spectra of the former group. The most peculiar object in the group is 21 Persei. In this one spectrum there are incorporated most of the peculiarities known among the A stars. The *Si* II doublet is strong, both *Mn* II and *Eu* II are well marked, *Sr* II 4077 and 4215 are unusually intense, and the unidentified line at λ 4200 is fairly strong.

8. The preceding discussion shows without any doubt that two, or even three, dimensions are insufficient for a general classification. Many other examples could be given which show the same differences in an equally convincing way. An examination of all of the stars located at the same position on two-dimensional diagrams shows conclusively that the dispersion in the intensity of different elements is not confined to those elements whose behavior has previously been considered to be peculiar. Dispersion considerably greater than can be ascribed to observational errors has been found for *Ca* I, *Ca* II, *Mg* II, *Sc* II, and *Fe* I, as well as for the "peculiar" *Si* II, *Sr* II, *Mn* II, *Eu* II, *Cr* I, *Cr* II, and *Y* II. Any complete scheme of classification of the A-type stars would have to be almost impossibly complex. For each spectrum to be satisfactorily located, the number of subdivisions necessary would be of the same order as the number of stars observed.

In spite of the absence of order in the behavior of the elements, or rather because of it, there are rather definite indications of a physical parameter additional to temperature and surface gravity.

The most likely explanation of the differences in intensity of certain elements from star to star is that the effective abundance is different in different objects. This is an agreement with the work of investigators of stars of other spectral types. In the O-type stars in emission, and in the late type stars in absorption, differences have been observed which can be explained only on the assumption that the actual effective amount of certain elements varies. Additional evidence is found in the A-type spectrum variables. For a number of these objects the changes cannot be interpreted in terms of changes in temperature or surface gravity but seem to be due to variations in effective abundance.

For all practical uses the original Henry Draper system of classification seems to be the most satisfactory for the A-type stars. The introduction of additional subdivisions in an attempt at greater refinement seems rather futile when there are so many outstanding cases of objects which will not fit even into a rough scheme. If the scheme of arranging the spectra in the order of intensity of K exclusively were to be adopted, the inconsistencies of other criteria would be even worse than in the Henry Draper system. Further, the good correlation between effective temperature and spectral type would probably be materially weakened.

II. THE SPECTRA OF THIRTEEN TYPE STARS

9. A group of thirteen stars which are representative of the various types of A spectra was selected for a more detailed investigation. The first subgroup includes three "normal" dwarfs: α Lyrae, γ Geminorum, and 15 Ursae Majoris. Vega is representative of the higher temperature A0 dwarfs in contrast to such slightly lower-temperature objects as Sirius, γ Geminorum, and the brighter component of Castor. *He* I 4471 is represented by a faint unblended stellar line on three-prism plates of all three stars while the iron arc spectrum is considerably weaker in Vega than in the other spectra. Helium disappears in the dwarfs within the range of stars classed as A0. The point of disappearance is well shown in the two brightest components of α Geminorum. λ 4471 is present in the brighter component and is absent in the fainter one, which is of slightly later spectral type. Intermediate between γ Geminorum and 15 Ursae Majoris is the spectrum of ϵ Serpentis which has been previously described.[2] The spectrum of 15 Ursae Majoris (A3p) is described as being composite by the *Henry Draper Catalogue*. The K line is only very slightly stronger than in γ Geminorum (A0) while the iron arc lines are almost as well developed as in Procyon (F5). The entire spectrum originates in one star as the radial-velocity displacements are the same for all lines. There is no possibility of accounting for the spectrum by assuming an overlapping of two stars of different spectral types. If the metallic spectrum originated in an F5 star, a very strong K line would be present. The intensity of K as actually observed is about that of the average A2 dwarf—far weaker than in such stars as Procyon.

All lines visible in the ordinary photographic region were measured for wave-length. I am indebted to Miss Christine Westgate for the measures of γ Geminorum. Three-prism plates which had been obtained on Eastman Process emulsion were used for the first two stars for wavelengths longer than λ 4340 for Vega and λ 4250 for γ Geminorum. Three-prism spectrograms were not available for 15 Ursae Majoris and one-prism plates on Eastman Process emulsion were used. The spectrum of the last star is too complex to be investigated adequately on one-prism plates, and it has only been included to show the general behavior of the elements on passing from class A0 to somewhat lower temperatures. The spectrum of γ Geminorum has been investigated by Albrecht.[3] While the main features of the two investigations are similar, Miss Westgate has measured considerably fewer lines than were measured by Albrecht.

While the stellar wave-lengths listed in Tables II–V should be of fair accuracy, they are not intended to serve as standards for radial-velocity determinations. The mean deviation of a line of intensity 2 or greater is about ± 0.06 A. Lines of intensity 1 may occasionally be in error by as

[2] *Ibid.*, **76**, 299, 1932.

[3] *Ibid.*, **72**, 65, 1930.

much as 0.3 A, while a few lines included of doubtful reality (1:) may differ from laboratory wave-lengths by 0.4 A. The one-prism plates used have a scale ranging from 16 A per millimeter at K to 41 A per millimeter at $H\beta$; the three-prism dispersion gives a scale of 8 A per millimeter at $H\gamma$ to 13 A per millimeter at $H\beta$. Plates of uniform quality were not available for all of the stars, and as a result fainter lines have been measured in some spectra than in others. An effort was made to reduce all intensity estimates to the same scale. The columns in Tables II, III, IV, and V give: (1) the wave-length to the whole angstrom; (2) the decimal of the wave-length as measured in each star; (3) the estimated intensity of the line; the last column gives the identifications.

Table II gives the wave-lengths and identifications for the three dwarfs Vega, γ Geminorum, and 15 Ursae Majoris. Relative contributions to blended lines have not been shown; they may be determined in any particular case by reference to Table VI on page 110, where the behavior of the elements is summarized. As in some of the wave-length tables (particularly the supergiants), stars of very different effective excitation are included, many contributors listed in the identification column apply to only one or two of the stars, and it should not be assumed that all contributors listed occur in all of the stellar spectra included in the table. For example, the many *Fe* I lines of intermediate intensity listed in the supergiant identifications apply to the F5 star ϵ Aurigae alone and chance coincidences with lines in hotter stars should be disregarded; in the opposite sense, there is a faint unidentified line in ϵ Aurigae agreeing in position with *He* I 4713, but the identification is intended for υ Sagittarii as helium is not present in ϵ Aurigae.

TABLE II

WAVE-LENGTHS AND IDENTIFICATIONS IN DWARFS

λ	Vega		γ Gem		15 U Ma		Identification
3913	.48	4	.47	3	.81	7	*Ti* II .46 (60) *Fe* I .64 (2) II *Fe* I 4.27 (1) *V* II 4.33 (20) *Ti* I 4.33 35 II
3915	.52	1	....	....	....	....	*Zr* II .94 (25)
3916	....	....	.56	2	.49	8	*Cr* I .24 (12) *V* II .42 (20) *Fe* I .74 (3) IV
3918	.31	1n	.56	2	.66	8	*Fe* I .32 (2) *Fe* I .42 (2) IV *Fe* I .65 (4) IV *Fe* I 9.07 (2) IV *Cr* I 9.16 (35n)
3920	.66	1	.38	2–3	.79	7n	*Fe* I .26 (6R) I ⊙ II .56 (4) ⊙ II .72 (4) *Fe* I .85 (1) *Cr* I 1.02 (20)
3922	.88	1	.88	2	.92	6	*Fe* I .92 (6R) I
3924	.86	1	.93	1	.31	3	*Ti* I .51 50 II *Fe* I 5.20 (1)
3926	.13	1	5.92	1	5.84	8	*Fe* I 5.65 (2) IV *Fe* I 5.95 (3) IV *He* I .53 (1)
3927	.74	2	.92	2	.88	8	*Fe* I .93 (6R) I
3929	....	....	.06	1	.44	3	*Ti* I .87 40 II
3930	.41	3	.31	2	.43	7	*Fe* I .30 (7R) I *Y* II .67 (15)
3931	.89	1:	.95	2	.93	3:	*Ti* II 2.01 (2)
3933	.58	7	.64	15	.63	20	*Ca* II .67 (10)
3936	.02	1	5.91	2	5.96	5	*Fe* I 5.82 (4) III *He* I 5.91 (1) *Zr* II .06 (7)
3938	.52	1	.32	3n	.30	8	*Mg* I .43 (3r)
3941	.00	1	.25	1–2	.03	4	*Fe* I 0.89 (4) II? *Fe* I .29 (2) *Cr* I .49 (20)
3942	.39	1:	.42	1–2	.56	3	*Fe* I .38 (1) *Fe* I .45 (3) IV

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
3943.......	.97	3	.99	3	4.14	4	*Al* I 4.03 (10R)
3945.......	.52	1	.18	1	.02	5	*Fe* I 4.75 (1) *Fe* I 4.90 (1) IV *Fe* I .12 (1) IV *Co* I .32 15 I
3947.......	.24	1	.40	2n	.45	3	*Fe* I .00 (2) IV *O* I .33 (10) *O* I .51 (7) *Fe* I .54 (2) IV *O* I .61 (4) *Ti* I .75 40 II
3949.......	.22	1	8.57	2	8.86	5	*Ti* I 8.66 60 II *Fe* I 8.78 (4) IV *La* II .05 (600) *Fe* I .14 (⊙ 2) *Fe* I .96 (4) III
3950.......	.53	1:	.09	1	.17	3	*Y* II .35 (200) *Fe* I 1.17 4 IV
3952.......	.00	1:	1.95	2	....	....	*V* II 1.97 (40) *Fe* I .61 (4) IV
3952.......	....	....	....	....	.66	5n	*Co* I .92 25 II *Fe* I 3.16 (2) IV
3955.......	....	....	.45	1	.23	2	*Fe* I .37 (2) IV
3956.......	.41	1	.52	2	.51	9	*Fe* I 5.96 (1) V *Ti* I .34 60 II *Fe* I .46 (4) IV *Fe* I .68 (6) III *Fe* I 7.04 (2) IV *Ca* I 7.05 10 III
3958.......	.42	1:	.19	2	.07	4	*Co* I 7.94 (15) II *Ti* I .21 80 II *Zr* II .23 (50)
3960.......	....	....	.12	1	9.97	3	*Fe* I 9.29 (1)
3961.......	.47	2	.55	3	.66	7	*Al* I .54 (10R)
3962.......	....	....	.94	1	3.35	3	*Fe* I 3.12 (2) V *Cr* I 3.69 (30)
3964.......	.20	1:	.56	2	.51	3	*Ti* I .27 35 III *Fe* I .52 (2) V *He* I .73 (4)
3966.......	.36	1	.73	1	.32	5	*Fe* I .07 (5) III *Fe* I .53 (1) *Fe* I .63 (5) IV
3968.......	.52	6	.36	10	.48	15	*Ca* II .46 (10)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
3970	.50	50*	.08	50	.10	12	*H*ε .08 (6)
3971	.....	.....	.....	.....	.84	5n	*Ni* I 2.16 10 I
3973	.93	1:	.....	.....	4.24	6n	*V* II .64 (15) *Fe* II 4.17 (*) *Fe* I 4.39 (1)
3976	.59	1	.....	.....	.59	5	*Fe* I .39 (1) *Fe* I .56 (1) *Fe* I .62 (2) IV *Cr* I .67 (25)
3978	.66	1:	.....	.....	.70	2n	*Fe* I .47 (1) *Co* I .66 10 *Co* I 9.53 10 I
3980	.42	1:	.....	.....	.....	.....	.....
3981	.....	.....	.90	2n	.59	3	*Ti* I .77 70r II *Fe* I .78 (3) III
3982	.....	.....	.....	.....	.30	3	*Ti* II .00 (tr) *Ti* I .48 30 II *Y* II .59 (150)
3983	.60	1:	4.11	1	.93	5–6	*Fe* I .96 (5) III
3984	.....	.....	.....	.....	.81	2	*Cr* I .34 (10) *Zr* II .75 (4)
3986	.29	1:	.....	.....	.33	2	*Fe* I .18 (3) IV
3986	.....	.....	.78	2n	7.04	3n	*Co* I 7.12 (6) I
3988	.....	.....	.....	.....	.39	3	*La* II .51 (500)
3989	.....	.....	.....	.....	.10	2:	*Sc* II .06 (1)
3989	.....	.....	.87	1	0.00	4	*Ti* I .76 80r II *Fe* I .86 (2) V *Fe* I 0.38 (1) V
3991	.....	.....	.25	2	.37	3	*Cr* I .12 (20) *Zr* II .14 (40) *Cr* I ..68 (10)
3992	.....	.....	.....	.....	.97	2	*Cr* I .85 (15) *Fe* I 3.11 (⊙ 2)
3994	.....	.....	.....	.....	.09	3	*Fe* I .12 (1) V
3995	.....	.....	.....	.....	.66	5–6	*Fe* I .22 (1) *Co* I .31 60 II *La* II .75 (400) *Fe* I .99 (⊙ 3) IV

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
3997.......	.29	1	.27	4	.31	6–7n	*Fe* I 6.97 (1) V *V* II .12 (15) *Fe* I .40 (6) III *Co* I .91 40 II *Fe* I 8.06 (5) III
3999.......	....	....	....	....	.00	4n	*Ti* I 8.63 100R II *Zr* II 8.97 (30) *Ti* I .34 7n III
4000.......	....	....	....	....	.37	3–4	*Fe* I .26 (1) *Fe* I .46 (1) V
4001.......	.74	1	....	....	.81	2–3	*Fe* I .67 (3) III
4002.......	....	....	.29	3n	.60	1	*Ti* I .47 9n III *V* II .95 (10)
4003.......	....	....	....	....	.85	1	*Fe* I .77 (1) V *Ti* I .79 10n III
4004.......	.82	2	5.32	5n	5.15	9	*Fe* I 5.25 (7) II *V* II 5.71 (60)
4006.......	.99	1:	....	....	.81	3n	*Fe* I .31 (2) IV *Fe* I .63 (1) IV *Fe* I .77 (1)
4007.......	....	....	....	....	.58	1	*Fe* I .27 (3) IV
4008.......	....	....	....	....	.79	1	*Fe* I .85 [2⊙] *Ti* I .92 35 II
4009.......	.77	1	.70	1n	.71	2–3	*Ti* I .65 15 II *Fe* I .71 (5) III
4010.......	....	....	....	....	.62	2	⊙ II .59 (3) *Fe* I .77 [2⊙] *Fe* I .95 (1)
4010.......	....	....	....	....	.99	1	*Fe* I 1.42 (1)
4012.......	.35	3	.41	6	.36	6	*Ti* II .37 (4)
4013.......	....	....	....	....	.99	2–3	*Ti* I .58 12n III *Fe* I .64 (1) *Fe* I .80 (2) V
4014.......	....	....	.32	1	.52	3	*Fe* I .28 (⊙2) *Sc* II .49 (8) *Fe* I .54 (4) III
4015.......	.70	1	.56	2	.51	3–4	*Ni* II .50 (1) ⊙ (I)? .61 (3–3)
4016.......	....	....	.96	1n	7.41	4	*Fe* I 7.10 (1) *Fe* I 7.15 (3) III

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4018.......	.69	1	.20	1	.20	4	*Mn* I .11 20 I *Fe* I .11 (2) *Fe* I .28 (2) *Zr* II .39 (10)
4020.......	....	....	.56	1	.28	3	*Fe* I .49 (1)
4021.......	.54	1	.87	2	.81	4	*Fe* I .62 (1) *Fe* I .87 (5) III *Fe* I 2.18 (⊙ 2)
4023.......	....	....	.38	2	.21	2–3	*V* II .38 (50)
4025.......	.12	1	4.82	4n	4.86	6n	*Zr* II 4.44 (12) *Ti* I 4.56 35 II *Fe* I 4.75 (2) *Ti* II .13 (2)
4026.......	.49	1	.46	1n	.25	2	*Fe* I .44 (1)
4027.......	....	....	....	....	.27	2	....
4028.......	.45	2	.33	5	.26	4	*Ti* II .33 (7)
4029.......	....	....	.50	1	.40	1	*Fe* I .64 (2) V *Zr* II .68 (20)
4030.......	.71	1	.64	3	.66	6–7	*Cr* II .37 (pred) *Fe* I .51 (3) IV *Mn* I .76 200 I
4031.......	....	....	....	....	.85	3–4	*La* II .70 (300) *Fe* I .97 (2) V
4033.......	.20	1	2.94	3	.07	5–6	*Fe* I 2.64 (1) III *Mn* I .07 150 I
4034.......	....	....	.36	2n	.47	4	*Mn* I .49 100 I
4035.......	....	....	.66	3	.73	5–6	*V* II .62 (40) *Mn* I .73 15 I
4036.......	....	....	.86	1n}	7.08	2	*V* II .77 (9)
4038.......	....	....	.22	1n}	7.91	2	*Fe* I 7.73 (1) *Cr* II .04 (2)
4038.......	....	....	....	....	.96	2	*Fe* I 8.82 (1)
4040.......	....	....	.18	2	.59	1	*Fe* I .10 (⊙ 2) *Zr* II .24 (4) *V* II .59 (4) *Fe* I .65 (1) V
4041.......	....	....	.33	2	.37	5–6n	*Fe* I .29 (1) *Mn* I .37 50r I
4042.......	....	....	.58	1	.70	3	*La* II .91 (300)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4043.......	.97	1	.94	2	.93	2	*Fe* I .90 (2) IV *Fe* I .99 (⊙ 2)
4044.......	....	....	.64	1	.94	1	*Fe* I .62 (2) IV *Fe* I 5.14 (1)
4045.......	.91	4	.79	8	.84	12	*Zr* II .62 (15) *Fe* I .82 (8) II
4047.......	....	....	.56	1	.14	2	*Fe* I .32 (1)
4048.......	.73	1	.88	3	.87	5–6	*Zr* II .67 (25) *Mn* I .76 15 I *Fe* I 9.34 (1)
4050.......	....	....	.30	1	.41	2–3	*Zr* II .33 (15) *Fe* I .68 (⊙ 2)
4051.......	....	....	....	....	.11	1	*V* I .04 (pred)
4051.......	.99	1:	.88	2	2.34	3–4	*Fe* I .93 (2) *Cr* II 2.00 (1) *Fe* I 2.31 (1)
4053.......	.83	1	.82	4	.87	4	*Ti* II .81 (3) *Fe* I 4.19 (⊙ 2)
4055.......	....	....	.09	1	.09	4n	*Fe* I 4.83 (1) *Fe* I 4.88 (1) V *Fe* I .05 (1) V *Mn* I .55 20 I
4055.......	.90	1	....	....	....	....	....
4056.......	....	....	.13	1	.30	1	*Ti* II .20 [1] *V* II .25 (2)
4057.......	.74	1	.50	3	.58	4	*Fe* I .36 (1) V *Mg* I .63 (5r)
4059.......	.15	1:	.37	1n	8.77	3	*Fe* I 8.77 (1) IV
4059.......	....	....	....	....	.94	2	*Fe* I .73 (1) V
4061.......	.46	1:	....	....	0.95	2	*Fe* I .12 (1)
4062.......	....	....	.45	1	.35	2–3	*Fe* I 1.96 (1) *Fe* I .45 (4) III
4063.......	....	....	....	....	.14	1	*Fe* I .30 (2)
4063.......	.46	3	.54	5	.61	8	*Fe* I .60 (8) II
4064.......	....	....	.92	1n	5.18	3	*Fe* I .46 (⊙ 3) *Ti* I 5.09 15 III *V* II 5.09 (6r) *Fe* I 5.40 (1) *Fe* II 5.77 (pred)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4066	....	....	....	....	.47	1	*Co* I .38 15 I *Fe* I .60 (1)
4067	.07	1	.00	4	.09	5–6	*Fe* I 6.98 (4) III *Ni* II .04 (3) *Fe* I .28 (3) III
4067	....	....	.95	1	8.12	2	*Fe* I 7.99 (5) III
4069	....	....	....	....	.19	2	*Fe* I .07 (⊙ 2)
4069	.91	1:	....	....	0.19	2	*Fe* I 0.28 (1)
4070	....	....	.72	1	.79	2	*Fe* I .78 (2) III *Cr* II .99 (2)
4071	.72	3	.72	4	.78	5–6	*Fe* I .53 (⊙ 2) *Fe* I .75 (7) II
4072	....	....	....	....	.62	1	*Fe* I .52 (1)
4073	....	....	....	....	.65	3–4	*Fe* I .77 4n IV
4074	....	....	....	....	.85	3	*Fe* I .79 (3) IV
4075	....	....	....	....	.95	2	*Fe* I .94 (1)
4076	....	....	.68	2	.61	2–3	*Fe* I .50 (1) *Fe* I .64 (5) IV *Fe* I .81 (1) *Cr* II .87 (pred)
4077	.59	3	.66	4	.75	11	*Cr* II .58 (pred) *Sr* II .71 400r
4079	....	....	....	....	.39	3	*Mn* I .25 12 I *Fe* I .25 (2) IV *Mn* I .43 10 I *Fe* I .85 (2) IV
4080	....	....	....	....	.37	2	*Fe* I .23 (2) IV)
4081	....	....	....	....	.25	2	*Fe* I 0.88 (1) *Fe* I .26 (⊙ 1)
4082	....	....	....	....	.20	2	*Fe* I .12 (1) *Fe* I .44 [⊙ 5]
4083	....	....	....	....	.36	3–4	*Fe* I .55 (1) *Mn* I .64 12 I *Fe* I .78 (1)
4084	....	....	.96	2	5.09	4	*Fe* I 5.01 (2) IV *Fe* I 5.31 (3) IV
4086	....	....	....	....	.79	4n	*Co* I .31 15 II *La* II .72 (350) *Fe* I 7.10 (1) *Fe* II 7.27 (*)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4088	...	...	...	...	.80	3	*Fe* I .57 (1) *Fe* II .73 (pred) *Cr* II .85 (pred) *Fe* I 9.22 (1)
4090	...	...	...	...	.48	3	*Fe* I .09 (1) *Zr* II .52 (10) *Fe* I .98 (1)
4092	...	...	...	...	.37	3	*Fe* I .29 (1) *Co* I .40 25 I *Fe* I .52 (1)
4093	...	...	...	...	.46	2	...
4094	...	...	...	...	.44	2	⊙ I? .42 (2N–2)
4095	...	...	...	...	.94	3–4	*Fe* I .98 (3) IV *Fe* I 6.12 (1) *Fe* I 6.22 (3)
4098	...	...	...	...	.29	3	*Cr* I 7.65 (20n) III *Cr* I 7.96 (20n) III *Cr* I .18 (20n) III *Fe* I .19 (3) II *Cr* II .48 (1) *Ca* I .55 15 III
4100	...	...	...	...	.58	3:	*Fe* I .17 (⊙ 2) *Fe* I .74 (2) II A
4101	.94	50	.74	50	.81	30	*Hδ* .74 (7)
4103	...	...	...	...	.07	3	*Si* I 2.95 (5)
4104	...	...	.42	2	3.98	3:	*Fe* I .14 (2) V
4105	...	...	...	...	.50	1	*V* I .17 60 I
4106	...	...	...	...	.29	1	*Fe* I .27 (1) *Fe* I .44 (1)
4107	...	...	...	...	.41	3–4	*Fe* I .50 (5) III
4109	.41	1:	.60	1	.42	4	*Fe* I .07 (1) *V* I .78 50 I *Fe* I .81 (4) IV
4110	.63	1:	.94	1	1.11	3–4	*Cr* I .87 (20n) III *Cr* II 1.04 (2) *Cr* II 1.36 (20n) III *Cr* II 1.67 (20n) III
4112	...	...	...	...	.81	3	*Fe* I .35 (1) *Ti* I .72 20 II *Fe* I .98 (2) V *Cr* II 3.29 (1)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4113	.97	1	....	....	....	....	....
4114	....	....	....	....	.71	3	*Fe* I .45 (4) IV *Fe* I .96 (1) *V* I 5.18 60 I
4116	....	....	....	....	.59	1	*V* I .48 50 I
4118	.45	1	.47	3	.51	6–7	*Fe* I .56 (6) IV *Co* I .78 50 II *Fe* I .90 (1)
4119	....	....	.49	2	.94	2	....
4120	....	....	.21	1	....	....	*Fe* I .21 (2) IV
4121	....	....	....	....	.48	3n	*Co* I .33 60 II *Fe* I .81 (2) IV
4122	.64	1	.59	3	.72	3–4	*Fe* I .52 (2) IV *Fe* II .67 (**)
4123	....	....	....	....	.56	3–4	*La* II .23 (400) *Fe* I .74 (1) *Fe* I .76 (1)
4125	.05	1	4.64	1	4.80	2	*Y* II 4.91 (15)
4125	....	....	.53	2n	.92	3n	*Fe* I .63 (1) *Fe* I .89 (1) *Fe* I 6.19 (2) IV
4127	.92	3	.97	8	.69	5–6	*Fe* I .61 (4) V *Fe* I .81 (2) V *Si* II 8.05 (8) *V* I 8.08 60 I
4129	....	....	....	....	.37	2–3	*Cr* I .37 20n III
4130	.84	3	.77	7	.70	3–4	*Si* II .88 (10)
4132	.38	1	1.96	3	.26	6–7	*V* I .02 60 I *Fe* I .06 (7) II *Mn* II .28 (1) *Cr* II .45 (1) ⊙ (I)? .54 (3–3)
4133	....	....	....	....	.17	1	*Fe* I 2.91 (3) III
4134	....	....	....	....	.24	2	*Fe* I 3.87 (2) *Fe* I .34 (1) *Fe* I .43 (1)
4134	.84	1	.52	1	.73	4	*V* I .50 60 I *Fe* I .68 (5)
4135	....	....	....	....	.82	2	....

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4137	.07	1	6.87	1	.25	5–6n	*Fe* I 6.53 (1) *Mn* II 6.91 (2) *Fe* I .00 (3) IV
4138	.53	1:	.59	2	.28	2	*Fe* I 7.98 *Fe* II .37 (*)
4138	....	....	....	....	.87	1	....
4140	....	....	....	....	.03	3	*Fe* I 9.93 (1) II A *Fe* I .40 (1)
4141	.10	1	....	....	.08	1	....
4142	....	....	....	....	.18	3	*Fe* I 1.86 (1) *Fe* I .63 1
4143	.42	2	.61	4	.66	8	*Fe* I .42 (5) III *Fe* I .87 (7) I
4144	....	....	....	....	.99	2	....
4145	.83	1	.66	2	.97	3–4	*Cr* II .81 (3) *Fe* I 6.07 (2)
4147	....	....	.42	1	.47	4	*Fe* I .67 (4) III
4148	.90	1	9.04	2	9.22	3–4	*Zr* II 9.21 (75) *Fe* I 9.37 (2) V
4150	....	....	....	....	.15	3	*Fe* I 9.77 (⊙ 2) *Fe* I .28 (2)
4151	.20	1:	....	....	0.84	2	*Zr* II 0.98 (10)
4152	....	....	.12	1	.06	5–6	*La* II 1.95 (250) *Fe* I 1.96 (1) *Fe* I .18 (2) II A
4154	.11	1	.26	4n	.72	8	*Fe* I 3.92 (4) IV *Fe* I .50 (4) III *Fe* I .82 4 IV
4155	....	....	....	....	.94	1	....
4156	....	....	.44	1	.41	6	*Zr* II .24 (15) ⊙ (I)? .31 (2–2) *Fe* I .46 (1) *Fe* I .67 (1) *Fe* I .81 (4) III
4157	....	....	....	....	.77	3	*Fe* I .79 (3) IV
4158	....	....	.83	1	.99	5	*Fe* I .80 (2) V
4160	....	....	....	....	.39	2	*Fe* I .56 (1)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4161	.31	1	.30	3	.50	6n	*Fe* I .08 (1) *Zr* II .21 (20) *Fe* I .49 (1) *Ti* II .52 (1) *Sr* II .81 (30)
4163	....	....	.58	5	.59	4	*Ti* II .65 (40) *Fe* I .68 (1)
4165	.39	1	....	....	.48	3–4	*Fe* I .42 (1)
4166	....	....	....	....	.79	1	....
4167	.46	1	.29	3	.31	4	*Mg* I .27 10n III
4167	....	....	....	....	.99	1	*Fe* I .86 (2) *Fe* I .96 (1)
4169	....	....	....	....	.34	1	*Fe* I 8.95 (1) *Fe* I .78 (1)
4170	....	....	....	....	.77	2–3	*Fe* I .91 (2) IV
4171	.97	1	.88	3	.97	4	*Fe* I .70 (2) *Fe* I .90 (2) *Ti* II .90 (30) *Fe* I 2.13 (3) IV
4173	.45	2	.50	5	.36	4	*Fe* I .32 (2) IV *Fe* II .48 (6) *Ti* II .54 (1)
4174	....	....	....	....	.65	2	*Fe* I .92 (2) II A
4175	....	....	.55	2	.57	3	*Fe* I .64 (4) III
4176	....	....	....	....	.77	2	*Fe* I .57 (2) IV
4177	.49	1	.65	3	.56	6	*Y* II .54 (125) *Fe* I .60 (2) II A
4179	.06	3	.02	5n	.12	6–7	*Fe* II 8.87 (6) *Cr* II .41 (2)
4180	....	....	....	....	.69	1	....
4181	.76	1	.74	2	.81	6	*Fe* I .76 (6) III *Fe* I 2.39 (2) IV
4183	....	....	....	....	.02	1	*Fe* I 2.79 (2) *V* II .43 (35)
4183	....	....	....	....	.92	4	⊙ II 4.00 (4)
4184	....	....	.42	2n	.73	2–3	*Ti* II .33 (0) *Fe* I .90 (4) III

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4185	....	....	....	....	.60	1	....
4186	....	....	.90	2	.96	6–7	*Fe* I 7.05 (6) III
4187	.36	1n	.80	3	.51	6–7	*Fe* I .59 (⊙ 2) *Fe* I .81 (6) III
4188	....	....	....	....	.89	4	⊙ (II)? .74 (4)
4190	....	....	....	....	.06	3	*Ti* II .29 [1]
4190	.88	1	....	....	....	....	*Si* II .74 (3)
4191	....	....	.44	2	.47	6–7	*Fe* I .45 (6) III *Fe* I .68 (2)
4192	....	....	....	....	.38	1	⊙ (I) .57 (2–2)
4193	.90	1	....	....	.47	2–3	....
4195	.28	1	.62	2n	.23	5–6	*Fe* I .34 (3) IV *Fe* I .62 (2)
4196	....	....	.40	1	.37	3–4	*Fe* I .22 (2) IV *Fe* I .53 (1) *La* II .55 (250)
4198	.41	1n	.31	3	.43	9n	*Si* II .17 (2) *Fe* I .27 (1) *Fe* I .31 (6) III *Fe* I .65 (2) V
4199	....	....	.16	3	.12	1	*Fe* I .10 (6) III *Y* II .28 (5)
4200	....	....	.76	2	.77	2	*Fe* I .92 (1) V
4202	.02	1	.08	4	.14	6–7	*Fe* I .03 (7) I *V* II .35 (35)
4203	....	....	.90	1	4.11	3	*Fe* I .95 (1) *Fe* I .99 (3) III *La* II 4.03 (100) *V* II 4.19 (8)
4205	....	....	.29	1	.14	5–6	*Y* II 4.69 (10) *V* II .09 (30) *Fe* I .54 (2)
4206	.39	1	....	....	.27	2	*Mn* II .43 (2) *Fe* I .70 (2) I A
4207	....	....	.33	1	.18	4	*Fe* I .13 (2) IV *Cr* II .34 (pred)
4209	.19	1:	8.78	1	8.79	3–4	*Fe* I 8.61 (2) V *Zr* II 8.98 (30)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4210.......	....	....	.35	2	.30	4	*V* II 9.80 (12) *Fe* I .36 (6) III
4211.......	....	....	....	....	.76	2	*Zr* II .88 (12)
4212.......	.43	1	.03	1	.37	2	....
4213.......	....	....	.61	1	.69	2	*Fe* I .42 (2) IV *Fe* I .65 (2) IV
4215.......	.32	2	.56	5	.59	9	*Fe* I .42 (2) IV *Sr* II .52 300r
4217.......	....	....	.46	2n	.49	5	*Fe* I .56 (2) IV
4218.......	.75	1	....	....	....	....	....
4219.......	....	....	.42	2n	.35	4	*Fe* I .36 (5) IV
4220.......	....	....	....	....	.23	3–4	*Fe* I .35 (2) IV
4222.......	.24	1:	.26	1	.39	5–6	*Fe* I .23 (5) III
4224.......	.40	1	.84	2n	.23	4	*Fe* I .17 (3) IV *Fe* I .51 (2) IV *Cr* II .85 (2)
4225.......	....	....	....	....	.30	5–6	*V* II .21 (20) *Fe* I .46 (4) IV
4226.......	.54	3	.75	4	.68	5–6	*Fe* I .43 (2) IV *Ca* I .73 500 I
4227.......	....	....	.43	2	.42	5–6	*Fe* I .45 (7) III
4229.......	.96	1	....	....	.57	2	*Fe* I .52 (1) *Fe* I .75 (1) III *Cr* II .82 (pred)
4231.......	....	....	....	....	.33	2	*Ni* I .05 5 V
4233.......	.17	5	.22	8	.26	8	*Fe* II .16 (8) *Cr* II .25 (1) *Fe* I .61 (6) III
4235.......	.98	1	.96	3	.78	6–7	*Y* II .73 (20) *Fe* I .95 (8) III
4237.......	.96	1	8.83	2	8.51	5–6	*Fe* I 8.04 (1) IV *La* II 8.38 (400) *Fe* I 8.83 (4) IV
4239.......	....	....	....	....	.90	5–6	*Mn* I .73 5 II *Fe* I .85 (2) III
4242.......	.25	1	.40	4	.47	5–6	*Cr* II .35 (5) *Mn* II .37 (2) *Fe* I .59 (1) *Fe* I .73 (2)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4243	...	...	...	...	.60	2	*Fe* I .37 (2) ⊙ (I)? .45 (3) *Fe* I .79 (1)
4244	...	...	.94	2n	5.27	3	*Ni* II .80 (1) *Fe* I 5.26 (2) III
4246	.85	3	.86	4	7.19	3–4n	*Sc* II .83 (100) *Fe* I 7.44 (5) III
4250	.51	2	.11	2	.39	6–7n	*Fe* I .13 (7) III
4250	...	...	.81	2	...	...	*Fe* I .79 (8) II
4252	...	...	.67	1	.53	3–4	*Cr* II .66 (1)
4253	.94	1n	4.39	3	4.33	6	*Cr* I 4.34 500 II
4255	...	...	...	...	.58	2	*Fe* I .85 (1)
4256	...	...	...	...	.32	4	*Fe* I .21 (2)
4257	...	...	...	...	.43	1	*Mn* I .66 5 II
4257	.97	1	8.21	3	8.18	5–6	*Zr* II 8.05 (12) *Fe* II 8.14 (*) *Fe* I 8.39 (1) I A *Fe* I 8.61 (1)
4260	.43	1	.47	4	.28	7	*Fe* I 9.99 (2) *Fe* I .14 (2) *Fe* I .49 (10) III
4262	.13	1	1.92	4	1.84	3	*Cr* II 1.91 (2)
4263	...	...	...	...	.54	2	...
4264	...	...	...	...	.31	1	*Cr* II .18 (pred) *Fe* I .21 (2) *Fe* I .74 (⊙ 2)
4267	...	...	...	...	.08	2	*Fe* I 6.97 (2) IV
4267	...	...	...	...	.72	1	*Fe* I .83 (2) IV
4269	.14	1	.29	2	.19	3	*Fe* I 8.75 (2) IV *Cr* II .30 (1)
4271	.70	3	.17	2	.50	8n	*Fe* I .17 (7) III
4271	...	...	.79	4	...	...	*Fe* I .76 (8) II
4272	...	...	.46	1	...	...	...
4273	...	...	.32	2	.21	4	*Fe* II .31 (1)
4275	.23	1	4.80	2n	.01	5–6n	*Cr* I 4.80 400 II
4275	...	...	.58	2	...	...	*Cr* II .56 (1)
4277	...	...	...	...	.01	2	*Fe* I 6.67 (1)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4278	.75	1:	.12	1	.13	2	*Fe* II .13 (1) *Fe* I .23 (1)
4279	....	....	....	....	.53	1	*Fe* I .48 (1)
4280	....	....	....	....	.72	2–3	*Cr* II 1.08 (pred) *Mn* I 1.10 6 II
4282	....	....	.48	2	.49	6	*Zr* II .20 (6) *Fe* I .41 (6) III
4283	.99	1:n	4.17	3	4.36	3–4	*Fe* I .90 (⊙ 2N) *Cr* II 4.24 (2)
4285	....	....	.45	1	.62	3	*Fe* I .45 (2) IV
4286	....	....	....	....	.38	2	*Ti* I .01 25 II *Fe* I .44 (1) *Zr* II .51 (5) *Fe* I .68 (1)
4287	.64	1	.87	3	8.00	4	*Fe* I .15 (2) *Ti* II .89 (2)
4290	.34	3	.23	6	.07	10	*Cr* I 9.73 (350)II *Ti* II .22 (50)
4292	.14	1	....	....	.18	2	*Fe* I .12 (pred) *Mn* II .28 (2) *Fe* I .29 (1)
4293	....	....	....	....	.19	1	....
4293	.78	3	4.12	6	4.18	6	*Ti* II 4.10 (40) *Fe* I 4.13 (6) II
4295	....	....	....	....	.47	2	*Cr* I .76 (15) III
4296	.52	2	.59	4	.37	6–7	*Fe* II .56 (6)
4297	....	....	....	....	.71	2	*Fe* I 8.04 (2) IV
4299	....	....	.17	2	....	....	*Fe* I .25 (7) III
4299	.98	4	0.04	6	.73	9n	*Ti* II 0.05 (60)
4300	....	....	.90	1	1.18	1	*Ti* I 1.09 50 II
4302	.07	1	1.93	3	.21	5	*Ti* II 1.93 (15) *Fe* I .19 (2)
4302	....	....	.56	1	....	....	*Ca* I .53 60 I
4303	.16	1	.18	5	.18	5–6	*Fe* II .18 (4)
4305	.09	1	.60	1n	.47	5–6	*Fe* I .46 (2) IV *Sr* II .46 (40) *Sc* II .71 (6) *Ti* I .91 60 II

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4306.......	....	....	....	....	.62	1	....
4308.....	.05	5	7.88	8	7.85	6	*Ca* I 7.74 45 I *Ti* II 7.86 (40) *Fe* I 7.91 (8R) II
4310.......	.26	1:	....	....	9.51	6–7	*Fe* I 9.04 (2) *Fe* I 9.38 (2) IV *Y* II 9.62 (50)
4311.......	....	....	....	....	.25	2	*Fe* I 0.78 (1) *Fe* I .45 (⊙ 2)
4312.......	.94	1	.88	4	.79	5–6	*Ti* II .87 (35)
4314.......	....	....	.14	3	....	....	*Sc* II .09 (30)
4314.......	.64	1	5.02	5	.87	7	*Ti* I .80 25 II *Ti* II .98 (40) *Fe* I 5.09 (5) III
4315.......	....	....	.90	1	....	....	....
4316.......	....	....	.80	1n	.52	3	*Ti* II .81 (1) *Zr* II 7.32 (12)
4317.......	.93	1	....	....	.45	2–3	....
4318.......	....	....	....	....	.90	3	*Ca* I .65 45 II
4320.......	.69	2	.84	4	.84	5–6	*Sc* II .73 (20) *Ti* II .97 (1)
4322.......	....	....	....	....	.52	2	*La* II .51 (100)
4323.......	....	....	....	....	.13	2	....
4325....... 4325.......	.66	3	.00 .74	2n 5	.69	8	*Sc* II .00 (20) *Fe* I .77 (9) II
4327.......	....	....	....	....	.38	3	*Fe* I .10 (2) V
4328.......	....	....	....	....	.73	2	....
4330.......	.44	1:	.56	1	.53	4	*Ti* II .26 (0) *Ti* II .71 (0)
4332.......	....	....	....	....	.66	1	....
4333.......	....	....	.34	3	.74	3–4	*Zr* II .27 (15) *La* II .77 (500)
4335.......	....	....	....	....	.40	2–3	....
4337.......	....	....	.92	3	.47	6–7	*Fe* I .05 (5) II *Ti* II .32 [1] *Cr* I .57 (30) I *Ti* II .92 (50)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4340	.46	50	.45	50	.47	30	*Hγ* .47 (8)
4341	...	...	.63	3	.59	3:	*Ti* II .37 (1)
4342	...	...	...	...	.89	2–3	...
4344	.32	1	.30	2	.31	5	*Ti* II .29 (2) *Cr* I .51 (40) I
4345	.72	1:	...	...	...	...	...
4346	.98	1:	...	...	.55	3	*Fe* I .56 (2)
4347	.83	1:	...	...	8.12	2	*Fe* I .85 (1)
4349	.30	1:	...	...	.29	1	*Fe* I 8.95 (☉ 2)
4350	.44	1:	.86	1	...	...	*Ti* II .86 (1)
4351	.64	4	.84	10	.82	8n	*Cr* I .06 (20) I *Fe* II .77 (6) *Cr* I .77 (60) I *Mg* I .94 30 IV
4352	.69	1:	...	...	...	...	*Fe* I .74 (4) III B
4354	.56	1:n	...	...	.74	2n	*Sc* II .60 (5) *Ca* I 5.10 25 III
4356	...	...	.82	1	...	...	...
4357	.44	1	.52	1	...	...	...
4358	.44	1:	...	...	.67	4n	*Fe* I .51 (2) IV *Y* II .73 (30)
4360	.08	1	...	...	...	...	*Zr* II 9.74 (10)
4361	...	...	.29	1	.87	3	...
4362	...	...	.20	1	.76	3	*Ni* II .10 (1)
4364	...	...	...	...	.49	3	...
4366	...	...	...	...	.12	1	*Fe* I 5.90 (1)
4367	.09	1:	.76	3n	.61	6	*Fe* I .58 (2) IV *Ti* II .66 (15) *Fe* I .91 (1) III A
4368	...	...	.37	1	...	...	*O* I .30 (10)
4369	.56	1	.50	2n	.64	5	*Fe* II .40 (*) *Fe* I .78 (3) III
4371	.64	1	.30	1	.27	3	*Zr* II 0.95 (8) *Cr* I .28 (20) I

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4372	.86	1	....	....	.94	2	*Cr* I 3.27 (8) I
4374	....	....	.43	3	....	....	*Sc* II .46 (30) *Fe* I .50 (1)
4374	.81	1:	.93	3	.83	6–7	*Ti* II .83 (1) *Y* II .94 (300)
4375	....	....	.97	1	.97	2	*Fe* I .93 (5) I, II
4377	.91	1:	....	....	.84	2	....
4379	.35	1	.57	1	.65	2n	*V* I .24 150 II *Zr* II .77 (9)
4380	.38	1	....	....	....	....	*Mg* I .39 (5)
4381	.54	1	....	....	0.97	1	....
4382	....	....	.44	1	.24	2	....
4383	.54	2	.60	5	.46	7	*Fe* I .55 (10) II
4384	.82	1:	.50	2n	....	....	*Mg* II .64 (8) *V* I .73 125 II *Sc* II .80 (5) *Cr* I .98 (20) I
4385	.48	1	.44	4	.26	5–6	*Fe* II .39 (5)
4386	....	....	.11	1	....	....	....
4386	.91	1	.89	2	.65	2	*Ti* II .86 (10)
4388	.26	1	.45	1	.31	5–6	*Fe* I 7.90 (2) IV *Fe* I .42 (2) IV
4390	.53	1n	.66	3	1.04	6n	*V* I 9.99 100 II *Mg* II .59 (10) *Fe* I .96 (3) IV *Ti* II .98 (tr) *Fe* I 1.46 (1)
4392	.94	1:	....	....	....	....	....
4393	.90	1	4.09	2	.86	2	*Ti* II 4.06 (2)
4395	.05	2	.06	5	.04	8	*Ti* II .04 (60) *V* I .24 80 II *Fe* I .29 (2) *Fe* I .51 (1)
4395	.99	1	.92	2	....	....	*Ti* II .85 (2)
4396	.97	1:	....	....	.49	1	....
4398	....	....	.21	1n	7.84	5	*Y* II .02 (50) *Ti* II .32 [1]

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4399.......	.67	1	.80	3	.77	4	*Ti* II .77 (35)
4400.......	.45	1:	.46	2	....	....	*Sc* II .38 (20) *Ti* II .63 (pred)
4400.......	.88	1	1.38	2	1.34	6–7	*Fe* I 1.30 (3) *Fe* I 1.45 (2) *Ni* I 1.55 30 III
4403.......	.17	1	....	....	.19	3	....
4404.......	.75	1–2	.75	4	.75	6–7	*Fe* I .75 (8) II
4406.......	....	....	....	....	.58	1	*V* I .65 80 I
4407.......	....	....	.72	1	....	....	*Ti* II .67 (1)
4408.......	.06	1	.42	1	.41	6n	*V* I .21 70 I *Fe* I .42 (4) III *V* I .51 90 I
4409.......	.11	1	.42	1	....	....	*Ti* II .25 (tr) *Ti* II .54 (tr)
4410.......	.05	1	....	....	0.63	4	*Fe* I .72 (2)
4411.......	.11	1	.11	2	....	....	*Ti* II .08 (15)
4412.......	.24	1	1.98	1	1.69	3	*Ti* II 1.95 (1)
4413.......	.57	1n	.59	1	.22	2	[*a Per* .64 (4n)]
4415.......	.11	1n?	.21	3n	4.96	6–7	*Fe* I .13 (8) II *Sc* II .56 (20)
4416.......	.01	1	....	....	....	....	....
4416.......	.78	1–2	.80	4	7.11	5–6	*Fe* II .81 (4)
4417.......	.78	1	.74	4	8.03	5–6	*Ti* II .72 (40)
4418.......	.68	1	.42	1	....	....	*Ti* II .34 (1)
4419.......	.59	1	....	....	....	....	*Mn* II .78 (2)
4420.......	.67	1:n	....	....	.53	2	....
4422.......	.22	1:n	1.88	2	.52	6	*Ti* II 1.95 (1) *Fe* I .57 (4) III
4422.......	.98	1:n	.60	1	....	....	*Y* II .59 (40)
4423.......	.90	1:	....	....	....	....	*Fe* I .86 (2r)
4425.......	....	....	.39	1	.17	3	*Ca* I .43 50 I *Fe* I .66 (1)
4427.......	....	....	.47	1n	.40	5–6	*Fe* I .31 (5) I

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4428	....	....	.02	1	.24	1	*Ti* II 7.89 (pred) *Mg* II .00 (7)
4429	....	....	....	....	.33	2	....
4430	.47	1	....	....	.28	5–6	*La* II 9.90 (400) *Fe* I .20 (2) IV *Fe* I .62 (4) III
4432	....	....	....	....	.65	2n	*Ti* II .08 (tr) *Fe* I 3.22 (2) IV
4433	....	....	.93	2	....	....	*Mg* II .99 (8)
4435	.22	1	.08	1	.36	2n	*Ca* I 4.95 60 I *Fe* I .15 (2) II A *Ca* I .67 40 I
4436	.35	1:n	.81	1n	....	....	*Mg* II .48 (5) *Fe* I .93 (2)
4437	....	....	....	....	.44	1	....
4438	....	....	....	....	.19	2	....
4439	.22	1	....	....	.55	2	*Fe* I .89 (2) IV
4440	.19	1	....	....	....	....	*Zr* II .46 (10)
4441	....	....	.68	1	.53	1	*Ti* II .73 (pred)
4442	.05	1:	.30	1	.50	1	*Fe* I .35 (5) III
4443	.00	1:	.03	1	....	....	*Zr* II 2.99 (25)
4443	.78	2	.84	6	.53	8n	*Fe* I .20 (3) III *Ti* II .80 (50)
4444	.83	1:	.66	1	....	....	*Ti* II .56 (1)
4446	.37	1:n	....	....	.69	3	*Fe* I .85 (2)
4447	.85	1	.70	1	.44	5	*Fe* I .14 (2) IV *Fe* I .73 (5) III
4449	.23	1:	.65	2	.44	1	....
4450	.55	1	.52	3	.45	4	*Fe* I .32 (2) *Ti* II .49 (10)
4451	....	....	.54	2	.64	2n	....
4452	.38	1	....	....	....	....	....
4453	.27	1	....	....	.34	1	*Fe* I .84 (⊙–2)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4454.......	.82	1:n	.84	3	.73	6–7	*Fe* I .39 (3) III *Fe* I .67 (1) *Ca* I .77 80 I *Zr* II .80 (10) *Fe* I 5.04 (2)
4456.......	.86	1	....	....	.40	2–3	*Ca* I .61 10 II *Ti* II .64 (tr)
4458.......	.15	1	....	....	7.47	2	*Zr* II 7.42 (8) *Ti* I 7.43 40 II *Mn* I 7.55 8 ? *Mn* I .26 12 II
4459.......	....	....	.19	2	8.87	5–6	*Ni* I .05 20 III *Fe* I .13 (5) III
4461.......	.29	1:	....	....	....	....	*Zr* II .23 (10)
4461.......	....	....	.74	2n	.65	7	*Fe* I .21 (2) *Fe* I .66 (4) I *Fe* I 2.01 (3) IV
4464.......	.43	1	.54	2	.48	5	*Ti* II .46 (1) *Mn* I .68 8 II *Fe* I .77 (2) IV
4466.......	.69	1	.52	2	.60	5	*Fe* I .56 (5) II *Fe* I .94 (2)
4467.......	.64	1:	.56	1	....	....	....
4468.......	.50	2	.53	5	.61	5–6	*Ti* II .49 (50) *Ti* II 9.15 (tr)
4469.......	.69	1n	.40	2	.89	1	*Fe* I .39 (4) IV
4470.......	.77	1	.80	1	.92	3–4	*Ni* I .49 15 III *Ti* II .86 (tr)
4471.......	.57	1	.63	1	....	....	*He* I .48 (6) *He* I .69 (1)
4472.......	.70	1	.97	2	.85	3–4	*Fe* I .71 (2) *Fe* II .91 (pred)
4474.......	.50	1	....	....	.37	1	....
4475.......	.82	1:n	6.03	2	.97	5	*Fe* I 6.02 (7) III
4477.......	.24	1n	....	....	....	....	....
4478.......	.74	1n?	.68	1	....	....	*Mn* II .74 (1)
4480.......	.05	1	....	....	9.34	2	....
4481.......	.26	9	.24	15	.25	9	*Mg* II $\left\{\begin{matrix}.13\\.33\end{matrix}\right\}$ (100)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4482	.39	1:	.35	1	.05	2	*Fe* I .18 (3) I *Fe* I .26 (4)
4483	.41	1	....	....	....	....	....
4484	.53	1:	....	....	.24	3–4	*Fe* I .24 (3) IV
4485	....	....	....	....	.68	2	*Fe* I .67 (2)
4486	....	....	....	....	.70	1	....
4488	.29	1	.28	2	.20	1	*Fe* I .13 (2) *Ti* II .32 (15)
4489	.20	1	.25	3	.04	5	*Fe* I 8.92 (2) IV *Fe* II .21 (4) *Fe* I .74 (3) I A
4490	.16	1:	....	....	....	....	*Mn* I .08 5 III *Fe* I .09 (2) IV
4491	.39	1	.36	4	.39	5	*Fe* II .41 (4)
4493	.27	1	.42	1	.83	2	*Ti* II .54 [1]
4494	.58	1	.46	1	.35	5–6	*Zr* II .41 (8) *Fe* I .57 (5) III
4496	.03	1	.38	1	.59	5	....
4496	.95	1:	....	....	....	....	*Cr* I .86 25R I *Zr* II .96 (15)
4498	.12	1:	....	....	.99	3	....
4499	.84	1	....	....	....	....	....
4500	.56	1:	....	....	.39	2	....
4501	.28	2	.30	6	.30	6	*Ti* II .27 (40)
4502	....	....	....	....	.97	1	....
4504	.89	1	....	....	....	....	*Cr* II .54 (pred)
4506	.61	1:	....	....	.07	2	*Ti* II .74 (pred)
4508	.29	2	.32	4	.33	6	*Fe* II .29 (8)
4511	....	....	....	....	.67	2	....
4512	.58	1n	....	....	....	....	*Ti* I .73 40 II
4513	....	....	....	....	.94	1	*Fe* I 4.19 (2)
4515	.38	1–2	.34	4	.28	5	*Fe* II .34 (6)
4516	.90	1:	7.18	1	....	....	....

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4518.......	....	....	.35	1	7.93	2	*Fe* I 7.53 (2) *Ti* I .03 50 II
4520.......	.32	2	.24	4	.15	5–6	*Fe* II .24 (6)
4521.......	....	....	.06	1	....	....	....
4521.......	.50	1	.72	1	....	....	....
4522.......	.79	2	.61	3	.81	7	*Fe* II .64 (6) *Ti* I .80 40 II
4524.......	.70	1:	.89	2	5.07	4	*Ti* II .74 [1?] *Fe* I 5.15 (3) IV *Ti* II 5.25 (pred)
4526.......	....	....	.45	1	.01	2	*La* II .12 (200) III *Cr* I .46 (15) II
4528.......	.75	1:	.56	3	.83	5–6	*Fe* I .62 (7) II
4529.......	....	....	.56	2	....	....	*Ti* II .51 (1)
4531.......	.83	1:	.29	1n	.42	5	*Fe* I .16 (5) II *Fe* I .64 (2)
4533.......	....	....	.03	1	.20	2	*Ti* I .25 80 II
4534.......	.10	2	.02	6	.04	6–7	*Ti* II 3.97 (30) *Fe* II .18 (*) *Mg* II .26 (4)
4535.......	.40	1:	....	....	....	....	*Ti* I .57 50 II
4536.......	....	....	....	....	.22	2	*Ti* I 5.92 40 II *Ti* I .05 40 II
4536.......	.90	1:	....	....	....	....	....
4537.......	....	....	.98	1n	....	....	....
4539.......	.55	1	.58	1	.32	2	....
4541.......	.43	1	.45	3	.55	5	*Fe* II .33 (1) *Fe* II .53 (*)
4542.......	.82	1	....	....	....	....	....
4544.......	.11	1	....	....	.98	2n	*Ti* II .03 (tr) *Cr* II .69 (pred)
4545.......	.12	1	....	....	....	....	*Ti* I 4.70 30 II *Fe* I .09 (⊙–2) *Ti* II .16 (tr)
4546.......	.96	1:	.63	1	7.37	2	*Ni* I .94 5 III *Fe* I 7.03 (2) *Fe* I 7.85 (3) V

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4549	.50	5	.55	10	.59	9	*Fe* II .48 (4) *Ti* II .62 (60)
4552	....	....	.24	1	1.82	2	*Ti* II .25 (pred) *Ti* I .46 35 II
4554	....	....	.09	2	.13	6	*Zr* II 3.96 (12) *Ba* II .04 1000R
4554	.85	1:	.98	2	....	....	*Cr* II 5.00 (2)
4555	.73	1	.90	3	.86	6	*Ti* I .49 30 II *Fe* II .90 (6) *Fe* I 6.13 (3) V
4557	.21	1:	....	....	....	....	....
4558	.67	2	.63	3	.57	6	*Cr* II .66 (20)
4560	.20	1:	....	....	....	....	*Fe* I .11 (2)
4561	....	....	....	....	.72	1	....
4562	.60	1:	....	....	....	....	....
4563	.77	1–2	.76	4	.80	4	*Ti* II .76 (30)
4564	....	....	.74	1	....	....	*V* II .59 (10)
4565	.57	1:	.70	1	.81	3–4	*Fe* I .32 (2) *Fe* I .68 (2) *Cr* II .78 (2)
4568	.18	1:	....	....	.74	2	*Ti* II .31 [1]
4570	.03	1:	....	....	....	....	....
4571	.97	2	.98	4	2.02	7	*Ti* II .97 (50)
4573	.20	1	....	....	....	....	....
4574	.24	1:	3.94	1	.44	2	*Fe* I .73 (2)
4576	.10	1	.34	2	.39	4	*Fe* II .31 (4)
4579	.55	1n	.85	1n	0.12	3n	*Fe* I .34 (1) *Cr* I 0.06 (20) I *La* II 0.08 (150) *Ti* II 0.47 [1]
4581	....	....	.47	1	....	....	*Ca* I .41 40 II *Fe* I .53 (2)
4582	.79	1	.82	1	....	....	*Fe* II .83 (*)
4583	.90	2	.82	5	.53	8n	*Ti* II .45 [1] *Fe* II .84 (8)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4585	.80	1	.88	1	6.41	2	*Ca* I .87 50 II
4588	.20	1	.23	3	7.94	3	*Cr* II .21 (20)
4589	.93	1	.98	2	.81	2	*Cr* II .94 (1) *Ti* II .96 (2)
4591	.92	1	2.13	2	2.21	6–7	*Cr* II 2.06 (2) *Ni* I 2.53 10 III *Fe* I 2.66 (4) I B
4593	.79	1	....	....	....	....	....
4595	....	....	.92	1	.67	4	*Fe* I .37 (2) *Fe* II .69 (*) *Fe* I 6.06 (2)
4598	....	....	....	....	.05	2	*Fe* I .14 (2)
4598	.98	1	....	....	....	....	....
4600	....	....	....	....	.33	5–6	*Fe* I 9.90 (2) *V* II .17 (8) *Ni* I .36 6 V
4602	....	....	.83	1	.58	2	*Fe* I .01 (2) *Fe* I .95 (4) I B
4605	....	....	.21	1	4.91	4	*Ni* I 4.99 12 III *Fe* I .25 (2)
4607	....	....	....	....	.64	2	*Sr* I .34 600 I *Fe* I .66 (4) V
4609	....	....	....	....	.07	1	*Ti* II .26 (pred)
4611	.19	1:	0.96	1	.28	3	*Fe* I .29 (4) III
4613	....	....	....	....	.28	3	*Fe* I .22 (3) V *La* II .40 (200)
4616	.66	1	.39	2	.17	3–4	*Cr* I .14 (25) I *Cr* II .67 (3)
4618	.82	1	.84	3	.86	6	*Fe* I .76 (2) *Cr* II .82 (10) *Fe* I 9.30 (4) IV
4620	.57	1	.48	2	.41	3	*Fe* II .52 (*)
4622	....	....	....	....	.37	2	....
4624	....	....	....	....	.74	2–3	*Cr* II .57 (2) *Fe* I 5.06 (4) IV
4626	.00	1:	5.78	1	5.96	2	*Cr* I .19 (20) I

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4629.......	.39	2	.36	4	.35	8	*Fe* II .33 (4) *Ti* I .34 15 III
4631.......	.36	1:	.47	1	....	....	....
4632.......	.63	1	....	....	....	....	*Fe* I .92 (3) III ?
4634.......	.07	1	.11	3	....	....	*Cr* II .09 (10)
4635.......	.68	1	.40	2	....	....	*Fe* II .35 [1]
4637.......	.61	1:	....	....	....	....	*Fe* I .51 (4) IV
4638.......	.21	1:	.08	1	....	....	*Fe* I .02 (4) IV
4639.......	.65	1	....	....	....	....	*Ti* I .37 18 III *Ti* I .67 15 III *Ti* I .94 15 III
4640.......	.79	1	.84	1	....	....	....
4646.......	.22	1n	....	....	....	....	*Cr* I .17 40 I
4648.......	....	....	.86	1n	....	....	*Fe* II .32 (*) *Ni* I .66 15 III
4651.......	.70	1:	....	....	....	....	*Cr* I .30 (20) I *Cr* I 2.17 (30) I
4653.......	.30	1	....	....	....	....	....
4654.......	.50	1	.16	1	....	....	*Fe* I .50 (4) II ? *Fe* I .64 (3) V
4655.......	.32	1	....	....	....	....	....
4656.......	.98	1:	7.07	3	....	....	*Fe* II 7.01 (*) *Ti* II 7.21 (tr)
4660.......	.57	1	....	....	....	....	....
4663.......	....	....	.04	1	....	....	....
4664.......	.32	1	3.83	1	....	....	*Fe* II 3.72 (*)
4666.......	.61	1	.64	2	....	....	*Fe* II .75 (*)
4667.......	....	....	.17	2n	....	....	*Fe* I .46 V
4668.......	.36	1	....	....	....	....	*Fe* I .15 (4) IV
4670.......	.10	1	.34	2	....	....	*Sc* II .40 (10)
4678.......	....	....	.71	1	....	....	*Fe* I .86 (5) V
4686.......	.17	1:	....	....	....	....	*Ni* I .21 5 III
4690.......	....	....	.40	2	....	....	*Fe* I .15 (2)

TABLE II—*Continued*

λ	Vega		γ Gem		15 U Ma		Identification
4691.......	.28	1:	....	....	....	....	*Fe* I .42 (4) IV
4693.......	....	....	.14	2	....	....	....
4698.......	....	....	.70	1	....	....	*Cr* II .74 (pred)
4699.......	....	....	.63	1	....	....	⊙ (II)? .34 (3–2)
4701.......	.16	1	....	....	....	....	....
4703.......	.07	1	2.94	4	....	....	*Mg* I .00 40 V

Table III lists the wave-lengths and identifications for the four "c"-stars η Leonis (A0p), υ Sagittarii (B8p, F2p), α Cygni (A2p), and ε Aurigae (F5p). The wave-lengths for η Leonis were determined from one-prism plates exclusively. The spectrum of the star is transitional between types B and A. All of the helium lines are faintly present, while at the same time the strongest lines of *Fe* I are also observed. Most of the wave-lengths in υ Sagittarii have been taken from Plaskett's[4] published measures. His wave-lengths have been extended somewhat toward the violet and have been supplemented elsewhere by a few lines due to singly ionized Argon. The Yerkes measures were made on plates of the Eastman 40 emulsion and consequently the intensity estimates are probably systematically less than for the stars measured on the Process plates. Plaskett's intensities have been reduced to a scale uniform with the other stars. The spectrum of υ Sagittarii is unique in the presence of a number of lines of *A* II[5] and in the strength of *S* II. In addition, the spectrum contains many peculiarities investigated in detail by Plaskett.[6] The wave-lengths in α Cygni depend on one-prism plates to the violet of λ 4340 and on three-prism plates to the red of that position. Struve's wave-lengths[7] in ε Aurigae between λ 3998 and λ 4340 have been used. To the red of λ 4340 the measures were made on three-prism Eastman 40 plates; an extension was made to the violet on one-prism Eastman 40 plates. The ultra-violet spectrum of α Cygni has been investigated by Wright and Miss Applegate.[8]

[4] *Pubs. D.A.O.*, **4,** 115, 1928.

[5] *Ap. J.*, **79,** 513, 1934.

[6] *Op. cit.*, **4,** 1, 1927.

[7] *Pubs. Yerkes Obs.*, **7,** Part II, 1932.

[8] L.O.B., **10,** 100, 1921; *ibid.*, **12,** 81, 1926.

TABLE III

WAVE-LENGTHS AND IDENTIFICATIONS IN SUPERGIANTS

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
3913....	.51	4	.45	3	.58	7	.17	10	*Ti* II .46 (60)
3914....	.58	2	.58	2–3	.59	3	.42	8	*V* II .33 (20)
3916....	.45	1n	....	....	.36	1	.22	6	*Zr* II 5.94 (25) *V* II .42 (20)
3918....	.68	1n	.38	2n	.62	1–2	.65	3	*Fe* I .32 (2) *Fe* I .42 (2) IV *Fe* I .65 (4) IV *C* II .98 (6) *Fe* I 9.07 (2) IV
3919....	.73	1	....	....	....	....	....	....	....
3920....	.63	2	.57	4	.85	1	.28	6	*Fe* I .26 (6R) I *C* II .68 (8)
3921....	.83	1	2.00	2	....	....	.52	3	⊙ II .56 (4) ⊙ II .72 (4)
3923....	.48	1n	.55	2	2.80	3	2.99	7	*Fe* I 2.92 (6R) I *S* II .43 (6)
3925....	....	....	....	....	.12	1:	....	....	*Fe* I 5.65 (2) IV *Fe* I 5.95 (3) IV
3926....	.53	1n	.66	4n	....	....	....	....	*He* I .53 (1)
3928....	.19	1	.56	2:	7.94	1–2	7.88	8	*Fe* I 7.93 (6R) I
3929....	.40	1	....	....	....	....	....	....	....
3930....	.30	3	.18	3	.31	4	.42	7	*Fe* I .30 (7R) I *Y* II .67 (15)
3931....	.91	2n	.94	2–3	2.08	2	....	....	*S* II .90 (5) *Ti* II 2.01 (2) *S* II 2.29 (3)
3933....	.65	12	.54	7n	.61	15	.69	50	*Ca* II .67 (10)
3934....	.95	1n	....	....	....	....	....	....	....
3935....	.92	3	6.00	4	.99	3	6.33	7	*Fe* I .82 (4) III *He* I .91 (1) *Zr* II 6.06 (7)
3936....	.89	1	....	....	....	....	....	....	....
3937....	.45	1	....	....	....	....	....	....	....
3938....	.31	2	.60	5n	.46	4r	.33	10	*Mg* I .43 (3r)

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
3939....	.03	1–2	....	....	....	....	....	....	....
3940....	.45	1n	....	....	.79	1	.66	3:	*Fe* I .89 (4) II?
3942....	.45	1	.14	1n	.08	1	1.79	2:	....
3942....	....	....	....	....	....	....	.75	3	*Fe* I .38 (1) *Fe* I .45 (3) IV *Fe* I 3.35 (1) IV
3944....	.00	2	3.86	1	3.99	1–2	.04	6	*Mn* II 3.86 (1) *Al* I .03 (10R)
3945....	.17	2	.32	2	.17	2	.26	8	*Fe* I 4.75 (1) *Fe* I 4.90 (1) IV *Fe* I .12 (1) IV
3946....	.12	1	....	....	....	....	....	....	....
3947....	.40	1n	....	....	.28	1	.24	4	*Fe* I .00 (2) IV *O* I .33 (10) *O* I .51 (7) *Fe* I .54 (2) IV *O* I .61 (4)
3948....	.80	1	....	....	....	....	.35	7	*Fe* I .11 (3) IV *Fe* I .78 (4) IV
3950....	.47	1	....	....	.02	1	.36	8	*Fe* I 9.96 (4) III *Y* II .35 (200)
3952....	.04	1	.08	2	1.98	1–2	1.94	9	*Y* II 1.59 (5) *V* II 1.97 (40)
3954....	.45	1:	....	....	....	....	.25	3	....
3955....	.65	1:	....	....	....	....	....	....	....
3956....	.73	1:	....	....	....	....	.19	5n	*Fe* I .46 (4) IV *Fe* I .68 (6) III
3957....	.82	1:	....	....	....	....	....	....	....
3958....	....	....	....	....	....	....	.19	6	*Zr* II .23 (50)
3959....	.09	1:	....	....	....	....	.60	2	....
3960....	.86	1	....	....	....	....	....	....	....
3961....	.54	1	.21	2	.55	2	.51	10	*Al* I .54 (10R)
3963....	.24	1n	....	....	....	....	2.87	2	[⊙ I 2.86 (3)]
3964....	.60	2	.73	5	.70	1–2	.42	7	*Fe* I .52 (2) V *He* I .73 (4)
3966....	.25	1n	.30	4	.61	1:	.23	6:	*Fe* I .07 (5) III *Fe* I .63 (5) IV

TABLE III—*Continued*

λ	η Leo		ν Sgr		α Cyg		ε Aur		Identification
3967....	.37	1:	....	....	....	....	....	....	....
3968....	.40	10	.48	5	.54	20	.51	50	*Ca* II .47 (10)
3970....	.15	20	.04	12	.13	25	.05	20	*H*ε .08 (6)
3972....	.35	1?*	....	....	....	....	....	....	....
3974....	.15	2	.34	9n	.10	4	3.97	10n	*V* II 3.64 (15) *Fe* II .17 (*)
3975....	.03	1	....	....	.05	1	....	....	....
3976....	.12	1	....	....	....	....	....	....	....
3976....	.91	1	.79	1	....	....	.43	1	*Fe* I .39 (1) *Fe* I .56 (1) *Fe* I .62 (2) IV
3977....	.87	1	....	....	.41	1	.72	3	*V* II .74 (10) *Fe* I .75 (5) III
3978....	.98	1:	....	....	....	....	....	....	....
3979....	.58	2n	.54	4n	.72	2n	.54	3	*Cr* II .21 (pred) *Cr* II .51 (2) *Fe* I .64 (⊙ 3) *S* II .81 (4)
3980....	.73	1	....	....	....	....	....	....	....
3981....	.51	1	....	....	.47	1	....	....	....
3982....	....	....	.18	2n	.13	1	.10	12	*Fe* I 1.78 (3) *Ti* II .00 (tr) *Y* II .59 (150)
3984....	....	....	....	....	....	....	.10	1	*Fe* I 3.96 (5) III
3986....	.06	1	5.93	1	....	....	....	....	*Mn* II 6.01 (1)
3987....	....	....	....	....	.75	1	.60	5	[⊙ II? .61 (2)]
3989....	.58	1	....	....	.14	1:	.98	1	*Sc* II .06 (1) *V* II .80 (4)
3990....	.96	1:n	.98	1	....	....	1.17	6	*S* II .90 (5) *Zr* II 1.14 (40)
3992....	....	....	....	....	....	....	.78	1	....
3993....	.97	1:	.57	2	....	....	....	....	*S* II .49 (6) *Mn* II .86 (1)
3995....	.09	1	.12	2n	....	....	....	....	*N* II .00 (10)
3997....	....	....	....	....	.25	1	.16	5	*V* II .12 (15) *Fe* I .40 (6) III

* 3972.35. Measured on two plates, but may be part of wing of *H*ε.

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
3998....	.97	1	.92	1	....	....	9.02	5	*S* II .74 (5) *Zr* II .97 (30)
4000....	.28	1:	....	....	....	....	.63	1	*Mn* II .06 (1) *Fe* I .26 (1) *Fe* I .46 (1) V
4001....	.11	1	....	....	....	....	....	....	....
4002....	.33	3n	.46	5n	.26	4n	.06	5	*Fe* I 1.67 (3) III
4003....	.52	1	....	....	....	....	2.85	4	*V* II 2.95 (10) *Cr* II .33 (2) *S* II .87 (2)
4004....	....	....	.93	1	....	....	....	....	....
4005....	.70	1n	.90	2n	.73	2–3n	.48	12	*Fe* I .25 (7) II *V* II .71 (60)
4006....	.86	1:	....	....	....	....	....	....	....
4007....	.91	1:	....	....	....	....	....	....	....
4009....	.32	1n	.26	5n	.30	1n	.90	2	*He* I .27 (1) *Fe* I .72 (5) III
4010....	.72	1	....	....	....	....	....	....	*Mn* II .84 (1)
4012....	.49	3v?	.59	4	.37	4	.37	13	*Ti* II .37 (4)
4013....	.96	1	.79	1	.64	1	....	....	*A* II .87 (10)
4014....	.90	1:	....	....	.22	1	.47	3	*Sc* II .49 (8) *Fe* I .54 (4) III
4015....	.64	3	.49	5	.35	2	.48	2	*Ni* II .50 (1)
4016....	....	....	.92	1	.92	1	7.18	1	*Fe* I 7.10 (1) *Fe* I 7.15 (3)
4017....	.49	1n	....	....	....	....	....	....	....
4018....	....	....	....	....	.34	1:	.39	2	*Fe* I .28 (2) *Zr* II .39 (10)
4020....	.06	1:	9.80	1	....	....	....	....	....
4020....	1.30	1:	....	....	.90	1	....	....	....
4021....	....	....	....	....	2.10	1	.96	2	*Fe* I .87 (5) III
4022....	.57	1:	....	....	....	....	....	....	....
4023....	.55	1	....	....	.37	1–2	.31	4	*V* II .38 (50) *He* I .99 (1)
4024....	.41	2–3	.78	1n	.51	4	.98	12	*Zr* II .44 (12)

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4025....	....	....	....	....	.15	1	....	....	*Ti* II .13 (2)
4026....	.18	2–3	.28	8	.23	1	....	....	*He* I .19 (5) *He* I .36 (1) *Al* II .5 (5)
4027....	.38	1:	....	....	....	....	....	....	....
4028....	.38	1	.56	2	.33	3	.29	10	*Ti* II .33 (7) *S* II .74 (7)
4029....	....	....	....	....	.42	1	.84	2	*Zr* II .68 (20)
4030....	.52	1	.42	1	.53	1	.71	3	*Cr* II .37 (pred) *Mn* I .76 200 I
4031....	.48	1	.47	2	.43	1	.75	1	*La* II .70 (300) *Mn* I .80 (4) *Fe* I .97 (2) V
4032....	.90	1–2	.96	5	3.01	2–3	.96	3	*S* II .77 (6) *Mn* I 3.07 150 I
4034....	.39	1	....	....	.39	1	.44	2	*Zr* II .09 (5) *Mn* I .49 100 I
4035....	.55	1n	.67	2n	.63	1	.64	3	*N* II .09 (4n) *V* II .62 (40)
4037....	.04	1:	....	....	6.89	1	6.86	2	*V* II 6.77 (9)
4038....	.07	1	.02	2n	.00	1	.12	1	*Cr* II .04 (2)
4040....	....	....	.09	1	9.61	1	9.71	1	*Zr* II .24 (4) *V* II .59 (4)
4040....	.00	1n	....	....	.65	1:	....	....	....
4041....	.40	1	.51	2	....	....	.20	1	*N* II .33 (5n) *Mn* I .37 50r I
4042....	.38	1:	.82	1	....	....	....	....	*A* II .91 (8)
4043....	.94	1n	4.08	4–5	.92	1–2	4.08	2	*Fe* I .90 (2) IV
4045....	.75	2–3	.87	1	.74	4	.78	12	*Zr* II .62 (15) *Fe* I .82 (8R) II
4047....	.36	1:	.05	1	....	....	....	....	....
4048....	.72	1–2	.92	5	.81	3	.70	4	*Zr* II .67 (25)
4050....	.56	1:n	....	....	....	....	.51	2	*Zr* II .33 (15)
4051....	....	....	.05	2	....	....	....	....	....
4051....	.89	2	.96	2	.82	2–3	.95	3	*Cr* II 2.00 (1)

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4053....	.92	1–2	.94	4	.82	4	.84	13	*Cr* II .45 (pred) *Ti* II .81 (3) *Cr* II 4.09 (pred)
4055....	....	....	....	....	.04	1:	.24	1	*Mn* I .55 20 I
4056....	.06	1n	.14	1	6.03	1	6.25	2	*Ti* II .20 [1] *V* II .25 (2)
4057....	.43	1	.34	2n	.54	1	.53	2	*Mg* I .63 (5r)
4058....	.49	1:	.69	1	....	....	....	....	....
4059....	....	....	....	....	.49	1	....	....	....
4060....	....	....	....	....	.55	1	....	....	....
4061....	.66	1:	.70	2	.80	1	....	....	....
4063....	.60	2	.97	2n	.63	3	.57	10	*Fe* I .60 (8R) II *Cr* II 4.05 (pred)
4065....	.11	1d?	....	....	.61	1:	.20	1	*V* II .09 (6r) *Fe* I .40 (1)
4067....	.05	4	.02	8	.06	4	.00	7	*Fe* I 6.98 (4) III *Ni* II .04 (3) *Fe* I .28 (3) III
4068....	.62	1:n	....	....	....	....	.25	2	*Fe* I 7.99 (5) III
4070....	.07	1	9.94	1	9.87	1:	.04	2	*Fe* I 9.28 (1) *O* II 9.64 (4) *O* II 9.90 (6)
4070....	....	....	.96	1	1.01	1	....	....	*Cr* II .99 (2)
4071....	.61	1	.85	1:	.71	2	.75	8	*Fe* I .75 (7R) II *A* II 2.01 (9)
4072....	.64	1	.70	2	....	....	.76	1	*O* II .16 (8) *Fe* I .52 (1) *Cr* II .63 (pred)
4073....	.89	1:	....	....	....	....	.84	1	*Fe* I .77 [⊙ 4] IV
4074....	....	....	....	....	.61	1:	....	....	*Fe* I .79 (3) IV
4075....	.44	1	.59	2n	.52	1	6.00	2	*Si* II .45 (2) *Cr* II .66 (pred) *O* II .87 (10) *Fe* I .94 (1) *Fe* I 6.50 (1)
4076....	.80	1	....	....	.58	1	....	....	*Fe* I .64 (5) IV *Si* II .78 (1) *Cr* II .87 (pred)

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4077....	.89	1	.50	2n	.64	3	.70	12	*Cr* II .58 (pred) *Sr* II .71 400r
4079....	....	....	....	....	.49	1:	....	....	....
4080....	.08	1:	9.86	1	....	....	....	....	....
4082....	.35	1	1.90	2n	.48	1:	....	....	....
4085....	....	....	.69	1	6.10	1	.72	2	*Fe* I .31 (3) IV *Zr* II .69 (5) *Cr* II 6.19 (1)
4087....	.50	1:	.30	1	.70	1	.29	2	*Fe* II .27 (*) *Cr* II .64 (pred)
4089....	....	....	.06	1n	....	....	8.89	2	*Fe* I 8.57 (1) *Fe* II 8.73 (*) *Cr* II 8.85 (pred) *Fe* I .22 (1)
4090....	....	....	....	....	....	....	.55	2	*Zr* II .52 (10)
4093....	....	....	.59	2n	.23	1:	....	....	....
4097....	....	....	.29	2	....	....	6.70	1	*Zr* II 6.63 (4)
4098....	....	....	.21	3n	....	....	.42	1	*Cr* II .48 (1)
4099....	....	....	.97	2	....	....	....	....	*S* II .27 (2) *S* II .42 (3) *Mn* II 0.00 (1)
4101....	.77	20	.72	7	.74	20	.77	20	*Hδ* .74 (7)
4103....	....	....	.77	1:	....	....	4.33	1	*A* II .91 (10) *Fe* I 4.14 (2) V
4104....	.99	1:	.91	1n	....	....	....	....	*Mn* II 5.01 (2)
4106....	....	....	.82	1n	....	....	....	....	....
4108....	....	....	....	....	.10	1n	7.48	2	*Fe* I 7.50 (5) III
4109....	.89	1:	.74	2	.96	1	.75	2	*Fe* I .81 (4) IV
4111....	.10	1	0.97	1	0.95	2	0.99	4	*Cr* II .04 (2)
4111....	....	....	.82	1	....	....	2.62	1	*Cr* II 2.57 (pred) *Fe* I 2.97 (2) V
4112....	.91	1:	....	....	3.02	1	3.26	3	*Cr* II 3.29 (1)
4114....	....	....	....	....	....	....	.94	1	*Fe* I .45 (4) IV *Fe* I .96 (1)
4116....	....	....	....	....	.52	1:n	....	....	....

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4118....	....	....	....	....	....	....	.57	3	*Fe* I .56 (6) IV
4119....	.28	1:	.49	1n	.34	1	.56	3	*O* II .22 (8)
4120....	.91	2	.79	2	.83	1	.99	1	*He* I .81 (3) *He* I .98 (1)
4122....	.65	4	.64	4	.64	6	.63	8	*Fe* II .67 (*)
4123....	....	....	....	....	.66	1:	....	....	*Fe* I .74 (1)
4124....	.71	1	.78	2	.59	2	.80	3	*Y* II .91 (15)
4125....	.62	1	6.30	1	....	....	....	....	*Mn* II .86 (1)
4128....	.13	6	.22	7	.09	7	.25	8	*Si* II .05 (8)
4128....	.76	1	....	....	.71	2	.76	8	*Fe* II .73 (*)
4129....	.49	1	....	....	....	....	....	....	....
4130....	.88	6	.86	8	.87	8	.76	3–4	*Si* II .88 (10)
4132....	.33	1	....	....	.20	1	.22	4	*Fe* I .06 (7) II *Mn* II .28 (1) *Cr* II .45 (1) *Fe* I .91 (3) III
4133....	.39	1:	....	....	....	....	....	....	....
4133....	....	....	....	....	....	....	.92	1	*Fe* I .87 (2)
4134....	.67	1:	....	....	.58	1:	.67	2	*Fe* I .68 (5) IV
4136....	.75	1	7.16	1	.02	1	.03	2	*Mn* II .91 (2) *Fe* I 7.00 (3) IV
4138....	.11	1:	.16	2	.28	1	.35	2	*Fe* II .37 (*)
4139....	.04	1:	....	....	....	....	....	....	....
4140....	....	....	....	....	.32	1:	.10	1	*Fe* I 9.93 (1) II A ⊙ II? .41 (3)
4141....	.26	1:	....	....	....	....	....	....	....
4142....	.29	1	1.92	2n	....	....	....	....	*S* II .24 (8)
4143....	.73	3	.69	5n	.79	2	.73	7	*Fe* I .42 (5) III *He* I .77 (2) *Fe* I .87 (7) I
4145....	.14	1:	.55	2	.79	2	.70	3	*S* II .05 (8) *N* II .76 (3) *Cr* II .81 (3) *Fe* I 6.07 (2)
4145....	.80	2	....	....	....	....	....	....	....

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4147....	.15	1:	.10	1	.10	1	....	....	*S* II 6.90 (5)
4147....	....	....	....	....	....	....	.73	1	*Fe* I .68 (4) III
4149....	.11	1:	....	....	.23	1	.17	7	*Zr* II .21 (75) *Fe* I .37 (2) V
4150....	.39	1:	....	....	....	....	....	....	....
4150....	....	....	.97	2	.76	1	.89	2	*Zr* II .98 (10)
4151....	.62	1:	....	....	....	....	....	....	....
4152....	....	....	....	....	....	....	.27	1	*La* II 1.95 (250) *Fe* I .18 (2) II A
4153....	.17	1	.00	4	.22	1:	....	....	*S* II .05 (10) *O* II .31 (7)
4154....	.80	1:	.67	1	.61	1:	.38	2	*Fe* I 3.92 (4) IV *Cr* II .29 (pred) *Fe* I .50 (4) III *Fe* I .82 (4) IV
4156....	.22	1:	.40	1n	....	....	.34	3	*Zr* II .24 (15) *Fe* I .81 (4) III
4158....	....	....	.16	1n	7.98	1:	7.98	1	*Fe* I 7.79 (3) IV
4158....	.50	1:	....	....	....	....	.64	1	*Fe* I .81 (2) V
4160....	.67	1	.77	2n	.54	1	....	....	....
4161....	....	....	....	....	.34	1	.37	9	*Zr* II .21 (20) *Ti* II .52 (1) *Sr* II .81 30
4162....	.45	1	.55	2	.96	1:	....	....	*S* II .29 (2) *S* II .64 (10)
4163....	.70	1–2	.62	4	.59	4	.59	12	*Ti* II .65 (40)
4165....	.32	1	.08	1	.25	1	.48	2	*S* II 4.98 (2) *S* II .20 (3) *Fe* I .42 (1)
4167....	.44	1	.08	1n	.14	1:	.29	2	*Mg* I .27 10n III?
4169....	.03	1:	8.65	2	8.48	1	....	....	*S* II 8.37 (5) *He* I 8.97 (1)
4170....	.85	1	....	....	.58	1	....	....	*Cr* II .65 (pred)
4171....	.87	1	.82	2	.93	3	.89	10	*Ti* II .90 (30) *Cr* II .92 (pred)
4173....	.46	5	.61	5	.48	8	.57	12	*Fe* II .48 (6) *Ti* II .54 (1) *S* II .97 (4) *Ti* II 4.09 (2)

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4174....	.47	1	....	....	....	....	....	....	*S* II .25 (5)
4175....	.76	1n	....	....	.05	1	.62	1	*Fe* I .64 (4) III
4176....	....	....	.00	1	.31	1	....	....	*N* II .17 (3n)
4177....	.75	2	.68	2	.65	3	.60	11	*Y* II .54 (125)
4178....	.91	5	.98	6	.90	8	.98	12	*V* II .39 (10) *Fe* II .87 (6) *Cr* II 9.41 (2)
4180....	.81	1	....	....	.83	1	....	....	....
4181....	....	....	....	....	....	....	.74	2	*Fe* I .76 (6) III
4182....	.62	1	3.25	1	....	....	3.54	2	*V* II 3.43 (35)
4184....	.19	1	.41	1	.03	1n	.33	3–4	⊙ II .00 (4) *Ti* II .33 (0) *Fe* I .89 (4) III
4186....	.10	1:	....	....	....	....	....	....	....
4187....	.81	1	.70	4n	6.92	1	.41	3–4	*Fe* I .05 (6) III
4187....	....	....	....	....	.72	1	....	....	*Fe* I .81 (6) III
4189....	.60	1	0.21	1n	0.26	1	0.37	2	*S* II .68 (4) *O* II .79 (10) *Ti* II 0.29 [1] *V* II 0.40 (4)
4190....	.88	1	....	....	....	....	....	....	*Si* II 0.74 (3)
4191....	.92	1	2.05	2	2.06	1	.52	3	*Fe* I .45 (6) III *Ni* II 2.07 (1)
4193....	....	....	.50	1	.40	1	....	....	....
4195....	....	....	.68	1n	.52	1	.35	2	*Fe* I .34 (3) IV *Fe* I .62 (2)
4196....	....	....	....	....	....	....	.22	2	*Fe* I .22 (2) IV
4198....	....	....	.24	1	.09	1	.60	3	*Si* II .17 (2) *Fe* I .31 (6) III
4198....	.93	1:	9.33	1	9.17	1	9.19	3	*Fe* I 9.10 (6) III *Y* II 9.28 (5)
4200....	.58	1	.57	4	.40	1	....	....	*Mn* II .25 (2)
4202....	.21	1	.55	2	.05	1	.17	7	*Fe* I .03 (7R) I *V* II .35 (35)
4204....	.25	1:	....	....	3.88	1:	.11	1	*Fe* I 3.99 (3) III *V* II .20 (8)

Table III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4205.	.27	1: †	.38	2n	.24	1	.16	4	*Y* II 4.69 (10) *V* II .09 (30) *Mn* II? .47 (1)
4206....	.38	1: †	...	...	...	...	...	...	*Mn* II .43 (2)
4207....	...	...	...	...	.27	1	.22	2	*Fe* I .13 (2) IV *Cr* II .34 (pred)
4208....	...	...	...	...	.77	1	9.00	4	*Zr* II .98 (30)
4210....	.01	1:	...	...	9.81	1	...	...	*V* II 9.80 (12)
4210....	...	...	...	...	...	...	.36	2	*Fe* I .36 (6) III
4212....	.10	1:	...	...	...	...	1.93	2	*Zr* II 1.88 (12)
4213....	...	...	...	...	...	...	.60	1	*Fe* I .65 (2) IV
4215....	.47	1	.66	2	.60	2	.56	12	*Sr* II .52 300r *Cr* II .78 (pred)
4217....	.10	1	.58	1n	.28	1	.41	2	*Cr* II .09 (pred) *S* II .19 (4) *Fe* I .56 (2) IV
4218....	.37	1:	...	...	...	...	...	...	...
4219....	.41	1	...	...	.09	1	.64	2	*Fe* I .36 (5) IV
4220....	.66	1:	...	...	.16	1	.39	1	*V* II .04 (4) *Fe* I .35 (2) IV
4222....	...	...	...	...	.14	1	.27	2	*Fe* I .23 (5) III
4222....	.99	1	.98	1	...	...	...	...	...
4224....	.03	1:	...	...	...	...	...	...	...
4225....	.01	1	4.78	1	4.84	1	4.98	3–4	*Cr* II 4.85 (2) *V* II .21 (20) *Fe* I .46 4 IV
4226....	.56	1	7.50	1	7.01	1	7.02	8n	*Ca* I .73 500 I *Al* II .81 (6)
4227....	.61	1	...	...	...	...	...	...	*Fe* I 7.45 (7) III *Al* II 7.49 (5)
4228....	...	...	...	...	.37	1	...	...	[*a* Per. 34? (1)]
4229....	.38	1	...	...	...	...	.23	1	*Fe* I .52 (1)
4231....	.20	1	0.53	1	0.22	1	...	...	*S* II 0.94 (4)
4233....	.11	10	.17	12	.05	12	.19	13	*Fe* II .16 (8) *Cr* II .25 (1) *Fe* I .61 (6) III

† Possibly 1 line?

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4234....	....	....	....	....	.65	1:	....	....	....
4235....	.77	1	6.49	1	.62	1	.97	4	*Y* II .73 (20) *Fe* I .95 (8) III
4236....	.92	1:	....	....	.43	1:	....	....	*N* II .98 (6n)
4238....	.64	1	.94	1	9.01	1	.70	3-4	*La* II .38 (400) *Fe* I .83 (4) IV
4240....	....	....	....	....	....	....	.21	1	*Fe* I .37 (2)
4241....	....	....	....	....	.03	1:	....	....	....
4242....	.31	3	.28	4	.32	4	.40	6	*N* II 1.80 (8n) *Mn* II .35 (2) *Cr* II .35 (5)
4244....	.56	1	.61	2	.62	1n	.55	1	*Mn* II .26 (1) *Ni* II .80 (1)
4245....	.90	1:	....	....	....	....	....	....	....
4246....	.79	2	.77	2	.89	3	.84	13	*Sc* II .83 (100) *Fe* I 7.44 (5) III
4247....	.89	1:	....	....	....	....	....	....	*Mn* II .95 (1)
4248....	.46	1	....	....	.37	1:	....	....	....
4250....	.30	1nd‡	.29	1	.19	1	.56	4	*S* II 9.94 (1) *Fe* I .13 (7) III *Fe* I .79 (8) II
4252....	.53	1r§	.75	2	.60	1-2	.62	3	*Cr* II .66 (1) **Mn* II 3.02 (2)
4254....	.46	1	.55	1	.53	1	.47	3	*Cr* I .34 (1000) II
4255....	.92	1:	....	....	6.18	1	6.18	2	*Fe* I 6.21 (2) ?
4258....	.19	2	.39	4n	.21	3	.17	8	*Zr* II .05 (12) *Fe* II .14 (*) *Mn* II 9.26 2
4259....	....	....	....	....	.13	1	....	....	....
4260....	.51	1	....	....	.31	1n	.52	5	*Fe* I .49 (10) III
4262....	.00	2	1.85	2	1.81	3-4	1.98	5	*Cr* II 1.81 (pred) *Cr* II 1.91 (2)
4263....	.94	1	.76	1	.96	1	.82	1	....
4265....	.57	1:	....	....	.43	1	....	....	....

‡ 4250 as two lines: 4250.18 1:; 4250.75 1.
§ 4252. Line probably present in red wing of 4252.53 at 4253.03.

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4266....	....	....	.73	1	.83	1:	....	....	*A* II .53 (10) *S* II .90 (4)
4267....	.08	1	.41	2n	....	....	....	....	*C* II .02 (8) *S* II .27 (4) *C* II .27 (10) *S* II .76 (6)
4267....	....	....	....	....	.90	1:	.51	1	*Fe* I 6.97 (2) IV *Fe* I .83 (2) IV
4269....	.38	1	.32	2	.26	1–2	.29	3	*Cr* II .30 (1) *S* II .72 (5)
4270....	....	....	....	....	.66	1	....	....	....
4271....	.04	1	....	....	.70	2	.70	7	*Fe* I .17 (7) III *Fe* I .76 (8R) II
4271....	.82	2	....	....	....	....	....	....	....
4273....	.29	2	.31	3	.32	2–3	.39	5	*Fe* II .31 (1)
4274....	.50	1:	....	....	....	....	....	....	*Cr* I 4.80 (300) II
4275....	.40	2	.54	2	.48	2	.41	4n	*Cr* II .56 (1)
4276....	.87	1:	....	....	7.24	1:	....	....	....
4277....	.96	2	8.40	4n	8.21	2	8.16	3–4	*Fe* II 8.13 (1) *S* II 8.51 (4) *V* II 8.92 (15)
4279....	.98	1:	....	....	0.16	1:	0.48	....	....
4282....	.30	1	.40	1	.50	1	.53	2	*Zr* II .20 (6) *Fe* I .41 (6) III *Mn* II .50 (3) *S* II .60 (4) *Ca* I 3.01 40 I
4284....	.16	2	.12	2	.35	2	.22	4	*Mn* II 3.84 (1) *Cr* II .24 (2)
4285....	.75	1:	.02	1	....	....	....	....	....
4286....	.28	1	.08	1	.39	1	.33	1	*Zr* II .51 (5)
4287....	.33	1:	....	....	....	....	....	....	....
4287....	.98	1	8.07	1	.93	1–2	.92	7	*Ti* II .89 (2)
4290....	.06	1–2	....	....	.27	4	.19	13	*Cr* I 9.72 (350) II *Ti* II .22 (50)
4292....	.17	1n	.30	1	.23	1	.21	1	*Fe* I .13 (pred) *Mn* II .28 (2) *Fe* I .29 (1)

TABLE III—*Continued*

λ	η Leo		ν Sgr		α Cyg		ε Aur		Identification
4294....	.13	2	.17	4	.12	4	.18	12	*Ti* II .10 (40) *Fe* I .13 (6) II *S* II .39 (6) *Sc* II .77 (5r)
4295....	.03	1::	....	....	....	....	....	....	....
4296....	.86	3	.57	4	.54	4	.59	8	*Fe* II .56 (6)
4297....	.68	1:	....	....	....	....	....	....	....
4298....	.54	1:	.20	1	.46	1:	....	....	....
4300....	.03	3	.00	4	9.97	4	.02	13	*Fe* I 9.25 (7) III *Ti* II .05 (60) *Mn* II .24 (1)
4301....	.79	1	.65	1	.91	2	2.04	8	*Ti* II .93 (15)
4303....	.17	5	.18	5	.28	4–5	.17	8	*Fe* II .18 (4)
4304....	.69	1	....	....	.69	1	....	....	....
4305....	.72	1:	.57	1	.67	1	.72	3	*Sr* II .46 40 *Sc* II .71 (6)
4306....	....	....	.81	1	....	....	....	....	....
4307....	.94	1–2n	.86	2	.81	3	.88	9	*Ti* II .86 (40) *Fe* I .91 (8R) II
4309....	.41	1	....	....	....	....	.66	3	*Y* II .62 (50)
4310....	.17	1	....	....	.41	1:	....	....	[*a* Per .49 (1)]
4311....	.30	1	....	....	....	....	....	....	....
4312....	.79	1	.88	2	.79	3	.89	7	*Ti* II .87 (35)
4314....	.08	2	.60	4n	.18	2	.68	13	*Sc* II .09 (30)
4315....	.01	2	....	....	.87	2	....	....	*Ti* II 4.98 (40) *Fe* I .09 (5) III
4317....	.31	1n	6.76	1	6.87	1	6.94	3	*Ti* II 6.81 (1) *O* II .16 (8) *Zr* II .32 (12)
4318....	.86	1:	.32	1n	....	....	.70	1	*S* II .64 (4) *Ca* I .65 45 I
4319....	.85	1	.66	1	.30	1:	....	....	*O* II .65 (8)
4320....	.82	1	1.12	1	.85	2n?	.85	9	*Sc* II .73 (20) *Ti* II .97 (1)
4322....	.35	1:	....	....	.17	1	....	....	....

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4322....	....	....	....	....	.90	1:	.68	1	*La* II .51 (100)
4323....	.42	1	.78	1	....	....	....	....	....
4324....	.98	1	....	....	....	....	....	....	*Sc* II 5.00 (20)
4325....	.64	3	.50	4	.52	2–3n	.36	11	*Fe* I .77 (9R) II
4326....	....	....	.77	1	....	....	....	....	*Mn* II .71 (3)
4328....	.07	1	....	....	....	....	....	....	....
4330....	.37	1	.52	1	.55	1n	.56	7	*Ti* II .26 (0) *Ti* II .71 (0)
4331....	....	....	.27	1:	....	....	....	....	*A* II .25 (10)
4332....	.03	1:	.11	1	....	....	....	....	....
4333....	....	....	....	....	....	....	.70	2	*Zr* II .27 (15) *La* II .77 (500)
4335....	.86	1:	....	....	....	....	....	....	....
4337....	.94	2	‖	....	.95	1	.87	10	*Ti* II .32 [1] *Ti* II .92 (50)
4340....	.39	20	.46	7	.45	20	.70	20	*H*γ .47 (8)
4344....	.08	1	3.66	2	3.10	1	3.29	2	*Fe* I 3.27 (2) *Fe* I 3.70 (2) *Mn* II .03 (1)
4344....	....	....	....	....	.21	2	.46	6–7	*Ti* II .29 (2) *Cr* I .51 40 I
4346....	.09	1:	....	....	....	....	....	....	....
4346....	....	....	....	....	....	....	.86	1:	*V* II .89 (2)
4348....	.53	1	.04	2–3	.53	1	.35	1:	*Fe* I 7.85 (1) *A* II .11 (20) *Mn* II .49 (1) *Fe* I .95 (1)
4350....	.11	1:	....	....	....	....	.85	2	*Ti* II .86 (1)
4351....	.79	7	.77	7	.80	10	.76	12	*Fe* II .77 (6) *Cr* I .77 60 I *Mg* I .94 30 IV
4354....	.37	1n	.40	1	.23	1	.55	2–3	*Sc* II .60 (5)
4356....	.39	1	....	....	.06	1	5.63	1:	....

‖ 4337. This line was considered to be a component to *H*γ by Plaskett in υ Sagittarii.

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4357....	.51	3	.51	2	.55	2	.47	2	[α Per .53 (2)]
4358....	....	....	....	....	....	....	.77	2	*Fe* I .51 (2) IV *Y* II .73 (30)
4359....	.22	1	.49	1	....	....	.69	3	*Zr* II .74 (10)
4361....	....	....	....	....	.18	1:	....	....	....
4361....	.40	1n	.77	4n	2.02	1	.95	1n	*Ni* II 2.10 (1)
4365....	....	....	.58	1	6.14	1	....	....	*Mn* II .29 (1)
4367....	.94	1	.83	1	.84	1	.69	5	*Ti* II .66 (15) *O* I 8.30 (10) *Fe* I 8.58 (2) IV
4369....	.46	2	.44	2	.39	2–3	.44	3	*O* II .28 (4) *Fe* II .40 (*) *Fe* I .78 (3) III
4370....	....	....	....	....	.84	1	1.11	1:	*Zr* II .95 (8)
4372....	.22	1:	....	....	.37	1:	....	....	[α Per .25 (2n)]
4373....	....	....	....	....	.18	1:	....	....	....
4374....	.64	1	.70	1	.67	1–2n	.58	6	*Sc II* .46 (30) *Ti* II .83 (1)
4374....	....	....	....	....	....	....	.94	6	*Y* II .94 (300)
4375....	....	....	....	....	....	....	.91	2	*Fe* I .93 (5) I, II
4376....	.79	1:	.99	2	7.09	1:n	7.63	1	[*Fe* I 7.80 (1)]
4378....	.59	1::	....	....	....	....	.86	2	....
4379....	....	....	....	....	....	....	.66	3	*Zr* II .77 (9)
4380....	.32	1:	.13	1n	....	....	.53	1:	*A* II 9.74 (8) *Mg* I .39 (5)
4381....	....	....	....	....	....	....	.94	1:	....
4383....	.38	1:	....	....	.48	2–3	.52	6	*Fe* I .55 (10R) II
4384....	.25	3	.93	5n	.33	2–3	.23	5	⊙ II .32 (1) *Mg* II .64 (8) *Sc* II .80 (5)
4385....	.27	5	....	....	.40	5	.42	7	*Fe* II .39 (5)
4386....	....	....	....	....	.83	1	.88	4	*Ti* II .86 (10)
4387....	.92	2n	.76	5n	.96	1	8.11	1:	*Fe* I .90 (2) IV *He* I .93 (3) *Fe* I 8.42 (2) IV

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TABLE III—*Continued*

λ	η Leo		ν Sgr		α Cyg		ε Aur		Identification
4388....	.84	1:	....	....	9.24	1	....	....	....
4390....	.56	3	.60	2	.65	3n	.87	3	*Mg* II .59 (10) *Fe* I .96 (3) IV *Ti* II .98 (tr)
4391....	....	....	....	....	....	....	.78	1:	....
4392....	.27	1:	.18	1	.27	1:	....	....	*S* II 1.81 (3)
4393....	.40	1:	....	....	.86	1	4.09	3	*Ti* II 4.06 (2)
4395....	.03	3	.20	5	.01	5	.20	14	*Ti* II .04 (60)
4395....	....	....	....	....	.86	1	.81	5:	*Ti* II .85 (2)
4396....	.46	1:	....	....	....	....	.89	1:	....
4397....	.71	1	....	....	....	....	.08	3	*Y* II 8.02 (50) *Ti* II 8.32 [1]
4399....	.77	2	.97	2n	.77	3	.77	6	*Ti* II .77 (35)
4400....	....	....	....	....	....	....	.29	6	*Sc* II .38 (20) *Ti* II .63 (pred)
4401....	....	....	....	....	.54	1	.28	1:	*Fe* I .30 (3) *Ni* I .55 30 III
4402....	.57	1	.93	2	.89	1	.75	1:	*S* II .64 (2)
4404....	.55	1	....	....	.76	1–2	.85	4	*Fe* I .75 (8R) II
4406....	.96	1:	....	....	.61	1:	....	....	....
4407....	....	....	....	....	.65	1	.66	2	*Ti* II .67 (1) *Fe* I .72 (2) III
4408....	.99	1:	....	....	....	....	.44	2	*Fe* I .42 (4) III
4409....	....	....	....	....	.51	1	.32	3	*Ti* II .25 (tr) *Ti* II .54 (tr)
4411....	.18	1	.04	1	.12	1–2	.03	3	*Ti* II .08 (15) *C* II .20 (2) *C* II .52 (2)
4411....	....	....	....	....	....	....	.91	4	*Ti* II .95 [1]
4412....	.31	1:	....	....	.36	1	.83	1:	....
4413....	.52	2	.70	2	.66	1–2	.68	4	[α Per .64 (4n)]
4415....	.02	1	....	....	.37	1	.38	7	*O* II 4.89 (10) *Fe* I .13 (8R) II *Sc* II .56 (20)
4416....	.91	4	.91	5n	.85	5	.76	7	*Fe* II .81 (4) *O* II .97 (8)

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4417....	....	....	....	....	.70	1	8.09	11	*Ti* II .72 (40) *Ti* II 8.34 (1)
4418....	.34	1:	....	....	....	....	....	....	....
4419....	.57	1	.46	2	....	....	....	....	*Mn* II .77 (2)
4421....	....	....	....	....	....	....	.10	1:	....
4421....	....	....	....	....	.98	1	.99	3	*Ti* II .95 (1)
4422....	....	....	....	....	....	....	.58	3	*Fe* I .57 (4) III *Y* II .59 (40)
4423....	.58	1:	....	....	....	....	....	....	....
4424....	.80	1:	....	....	....	....	.30	1:n	....
4425....	....	....	.26	1: }	....	....	.49	2	*Ca* I .43 50 I
4426....	....	....	.02	1–2 }	....	....	....	....	*A* II .01 (15)
4428....	.04	1	7.86	1	7.97	1	7.38	1n	*Fe* I 7.31 (5) I *Ti* II 7.89 (pred) *Mg* II .00 (7)
4430....	.05	1:	.03	1	....	....	9.87	1:	*La* II 9.90 (400) *A* II .18 (9)
4431....	.24	1	.18	2	....	....	.76	1:	*S* II .00 (2) *Sc* II .35 (3) *Ti* II 2.08 (tr)
4432....	.73	1:	....	....	.60	1	....	....	....
4434....	.03	3	3.95	2	3.96	1	3.47	1	*Fe* I 3.22 (2) IV *Fe* I 3.81 (2) *Mg* II 3.99 (8)
4434....	....	....	....	....	....	....	.80	1:	*Ca* I .95 60 I *Fe* I 5.15 (2) II A
4436....	.53	1	.24	1	.41	1:	....	....	*Mg* II .48 (5)
4437....	....	....	.47	2n	....	....	....	....	*He* I .55 (1)
4438....	.20	1:	....	....	....	....	....	....	....
4440....	.01	1:	.40	1	....	....	.14	2	*Fe* I 9.89 (2) IV *Zr* II .46 (10)
4442....	.02	1	1.89	1	.12	1	1.70	3	*Ti* II 1.73 (pred) *Fe* I .35 (5) III
4443....	....	....	....	....	....	....	.21	2	*Zr* II 2.99 (25) *Fe* I .20 (3) III

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4443....	.89	3-4n	.98	3	.84	4	.63	10:	*Ti* II .80 (50)
4444....	.90	1:	....	....	.46	1:	.37	7:	*Ti* II .56 (1)
4446....	.25	1	.58	1	5.96	1	.08	1	....
4447....	....	....	.73	1:n	.41	1	.76	2	*N* II .04 (10) *Fe* I .73 (5) III
4448....	.54	1::	....	....	.58	1	....	....	....
4449....	....	....	....	....	.60	1	.24	2	....
4450....	.57	1	.44	1	.44	2	.54	8	*Ti* II .49 (10)
4451....	.80	1	.52	1n	.60	1-2	.47	1	*Mn* I .58 15 II
4452....	....	....	....	....	.53	1:	3.07	1:	*Mn* I 3.01 6 III
4453....	.30	1:	....	....	.63	1	....	....	....
4455....	.01	2	.22	1	.30	2	4.75	3	*Ca* I 4.77 80 I *Zr* II 4.80 (10) *Mn* I .02 5 III *Mn* I .32 6 III?
4456....	.95	1:	.41	1	.65	1	.33	1	*Ca* I 5.88 40 I *S* II .39 (4) *Ti* II .64 (tr)
4457....	.21	1:	....	....	....	....	.23	1:	*Zr* II .42 (8)
4458....	.88	1:	....	....	.91	1:	9.20	3	*Ni* I 9.05 20 III *Fe* I 9.13 (5) III
4460....	....	....	....	....	.45	1:	....	....	....
4461....	.24	1 ¶	.57	2	.57	2	.51	4	*Zr* II .23 (10) *Fe* I .66 (4) I *Mn* I 2.03 20 III
4462....	.01	1	....	....	....	....	....	....	
4463....	....	....	....	....	.04	1:	2.85	1	....
4464....	.06	1n	.19	1:	.45	2	.38	7	*S* II 3.58 (7) *S* II .44 (6) *Ti* II .46 (1)
4465....	.58	1:	....	....	....	....	....	....	....
4466....	.67	1:	....	....	.46	1	.36	2	*Fe* I .56 (5) II
4468....	.47	3	.46	2	.49	4	.66	10	*Ti* II .49 (50) *Ti* II 9.15 (tr) *Fe* I 9.39 (4) IV
4470....	.10	1:	9.99	1	....	....	....	....	....

¶ 4461. May be one line 4461.63 int. 2n.

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4470....	....	....	....	....	.88	1	.84	5	*Ti* II .86 (tr)
4471....	.57	3	.54	6	.46	1	....	....	*He* I .48 (6) *He* I .69 (1)
4472....	.83	1	.89	1	.94	2	.95	4	*Fe* II .91 (*)
4475....	....	....	.63	1	....	....	....	....	....
4476....	.27	1	....	....	5.90	1:	.01	2n	*Fe* I .02 (7) III
4478....	....	....	.50	1	....	....	8.10	1:	*Mn* II .74 (1)
4479....	....	....	....	....	....	....	.62	1:	*Fe* I .61 (2)
4481....	.26	10	.12	9	.25	12	.22	10	*Mg* II $\left\{\begin{matrix}.13\\.33\end{matrix}\right\}$ (100)
4483....	....	....	.53	1	....	....	....	....	*S* II .42 (6)
4487....	....	....	.14	1n	....	....	....	....	*S* II 6.63 (3)
4488....	....	....	....	....	.36	1	.31	4	*Ti* II .32 (15)
4489....	.19	2	.20	2	.19	3–4	.10	7	*Fe* II .21 (4)
4491....	.32	3	.49	2	.40	4	.42	6	*Fe* II .41 (4)
4493....	.28	1	.91	1	....	....	.55	2	*Ti* II .54 [1]
4494....	....	....	....	....	....	....	.53	2	*Zr* II .41 (8) *Fe* I .57 (5) III
4496....	....	....	....	....	....	....	.79	2	*Zr* II .97 (15)
4499....	....	....	.42	1	....	....	....	....	....
4501....	.32	1–2	.21	1	.28	3–4	.28	11	*Ti* II .27 (40)
4504....	....	....	.48	1	....	....	....	....	*Cr* II .54 (pred)
4506....	....	....	....	....	....	....	.60	1:	*Ti* II .74 (pred)
4508....	.32	3–4	.41	5	.29	5	.31	10	*Fe* II .29 (8)
4511....	....	....	....	....	.74	1:	.16	1:	....
4512....	....	....	.29	2	....	....	....	....	....
4515....	.30	4	.39	5	.37	5	.36	10	*Fe* II .34 (6)
4518....	.13	1:	....	....	....	....	.36	2	[α Per .36 (4w)]
4520....	.20	2	.19	5	.21	4	.24	9	*Fe* II .24 (6)
4522....	.67	3–4	.67	5	.65	5	.66	10	*Fe* II .64 (6)

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4524....	.75	1:	5.04	1	.99	1	.92	2	*S* II .65 (2) *Ti* II .74 [1?] *S* II .96 (6) *Fe* I 5.15 (3) IV *Ti* II 5.25 (pred)
4526....	.15	1::	....	....	.35	1	.35	1	....
4528....	....	....	....	....	.30	1	.57	3	*Fe* I .62 (7) II
4534....	.14	2–3	.10	4	.04	5	.11	12	*Ti* II 3.97 (30) *Fe* II .18 (*) *Mg* II .26 (4) *S* II .39 (4d)
4539....	....	....	.95	1n	....	....	.70	2	[α Per .71 (3)]
4541....	.51	2	.52	4	.53	3–4	.55	5	*Fe* II .33 (1) *Fe* II .53 (*)
4544....	....	....	....	....	....	....	.06	3	*Ti* II .03 (tr)
4544....	....	....	.85	1	.92	1	5.07	2	*Cr* II .69 (pred) *A* II 5.08 (10) *Ti* II 5.16 (tr)
4548....	....	....	....	....	....	....	.26	1:	*Fe* I 7.86 (3) V
4549....	.51	7	.57	6	.53	12	.66	12	*Fe* II .48 (4) *S* II .56 (4) *Ti* II .62 (60)
4552....	.71	1:	.39	1	.27	1	.23	3	*Ti* II .25 (pred) *S* II .37 (5) *N* II .50 (4) *Si* III .61 (9)
4554....	....	....	....	....	....	....	.02	3	*Zr* II 3.96 (12) *Ba* II .04 1000R
4554....	....	....	....	....	.96	2	5.03	2	*Cr* II 5.00 (2)
4555....	.65	3	.74	4	6.00	6	.89	9	*Fe* II .90 (6) *Fe* I 6.13 (3) V
4558....	.67	3	.68	4	.66	6	.73	7	*Cr* II .66 (20) *Cr* II .78 (pred)
4560....	....	....	....	....	.87	1::	1.18	2	[α Per .25 (1n)]
4561....	....	....	.82	1	....	....	2.50	1	....
4563....	.68	1	.67	2	.79	3	.91	9	*Ti* II .76 (30) *V* II 4.59 (10)
4566....	....	....	.02	1	5.77	2	5.58	2	*Cr* II 5.78 (2)
4568....	....	....	.30	1	7.79	1:n	.33	2	*Si* III 7.83 (7) *Ti* II .31 [1]

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4569....	...	...	...	...	...	...	.92	1:	...
4571....	.93	1–2	2.01	2	.97	3–4	2.00	10	*Ti* II .97 (50)
4576....	.48	2	.26	2	.36	3	.29	6	*Fe* II .31 (4)
4577....	...	...	...	...	.84	1	...	...	...
4579....	.79	1n	.96	2	.90	2n	0.15	3	*La* II 0.08 (150) *Ti* II 0.47 [1]
4581....	...	...	...	...	.36	1	...	...	[*Ca* I .41 40 II]
4582....	...	...	...	...	.82	1–2	.85	4	*Fe* II .83 (*)
4583....	.77	5v	.68	5n	.89	8	.86	12	*Ti* II .45 [1] *Fe* II .84 (8)
4585....	...	...	...	...	.87	1	...	...	*Al* II .82 (6)
4588....	.27	2	.18	5	.19	3–4	.17	6	*Al* II .19 (5) *Cr* II .21 (20) *Cr* II .40 (pred)
4589....	...	...	.99	1	.85	1–2	.94	4	*Cr* II .89 (pred) *A* II .93 (9) *Cr* II .94 (1) *Ti* II .96 (2)
4592....	.21	1	.10	1	.03	2	.08	3	*Cr* II .06 (2)
4593....	...	...	.86	1	.92	1	.97	2	...
4595....	.77	1	.97	2	.90	2	.88	2	*Fe* II .69 (*) *Fe* I 6.06 (2) *O* II 6.19 (8)
4598....	.67	1	.61	1	.22	1	.14	1	...
4600....	...	...	...	...	.15	1:	.11	1:	*V* II .17 (8) *Ni* I .36 6 V
4601....	...	...	.42	2n	...	...	.33	1:	*Fe* II .38 (*) *N* II .49 (8)
4602....	...	...	...	...	...	...	.96	1	...
4604....	...	...	...	...	...	...	.90	1n	...
4605....	...	...	.04	1	...	...	...	...	...
4607....	...	...	.33	1	...	...	...	...	*N* II .17 (7)
4609....	...	...	.80	1	...	...	.46	1	*Ti* II .26 (pred) *A* II .60 (15)
4611....	...	...	...	...	...	...	.45	1	...

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4613....	....	....	....	....	....	....	.40	1	*Fe* I .22 (3) V [*La* II .40 200 VE]
4616....	.73	1	.73	2	.69	2	.66	4	*Cr* II .67 (3)
4618....	.83	1–2	.95	2	.85	2–3	.82	6	*Cr* II .82 (10)
4620....	.65	1	1.29	2n	.53	2	.57	5	*Fe* II .52 (*) *N* II 1.41 (7) *Cr* II 1.48 (pred)
4623....	....	....	....	....	.18	1:	....	....	....
4625....	....	....	.81	1	.69	1:	.89	1:	....
4629....	.33	2–3	.53	4n	.34	4	.33	8	*Fe* II .33 (4) *N* II 0.55 (10)
4631....	....	....	....	....	.72	1	.91	1	....
4634....	....	....	.08	2	.05	2	.08	5	*Cr* II .09 (10)
4635....	....	....	.31	1	.42	2	.36	2	*Fe* II .35 [1]
4637....	....	....	.85	1	8.14	1	....	....	*Fe* I 8.02 (4) IV
4640....	....	....	.78	1	....	....	....	....	....
4642....	....	....	.93	1	....	....	....	....	....
4648....	....	....	.55	1	9.02	1	....	....	*S* II .14 (3) *Fe* II .32 (*)
4657....	....	....	.11	2	.04	2	.08	4	*S* II 6.75 (5) *Fe* II .01 (*) *Ti* II .21 (tr)
4659....	....	....	....	....	....	....	.33	1	....
4660....	....	....	....	....	....	....	.84	1:	....
4663....	....	....	.31	4	.30	2n	.77	2	*Fe* II .72 (*)
4666....	....	....	.94	1	.76	2–3	.75	3	*Fe* II .75 (*)
4670....	....	....	.39	1	.16	2	.28	4	*Sc* II .40 (10)
4673....	....	....	.47	1	2.67	1:	....	....	⊙ II 2.34 (3n)
4674....	....	....	....	....	.52	1:	....	....	....
4679....	....	....	.07	1n	....	....	.01	1	....
4680....	....	....	....	....	....	....	.25	1	*Zn* I .14 (10R)
4682....	....	....	....	....	....	....	.69	1	*Y* II .32 (20)
4685....	....	....	....	....	....	....	.06	1	....

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4687							.48	1:	
4691							.30	1:	
4698							.69	1	*Sc* II .28 (1) *Cr* I .48 (3) *Cr* I .62 (3) *Cr* II .74 (pred)
4702							.97	2	*Mg* I 3.00 40 V
4707							.44	1:	
4708							.75	3	*Ti* II .66 (tr)
4710							.16	1	
4711							.35	1	
4713			.25	4			2.87	1	*He* I .14 (3) *He* I .37 (1)
4713							.99	1:	*Ni* I 4.42 25 II
4716			.38	2					*S* II .25 (7)
4719							.45	1n	*Ti* II .51 (1)
4721							.45	1	
4723			.23	1			.24	1	
4726			.96	1					*A* II .91 (10)
4727							.85	1n:	[*Mn* I .46 10 III]
4731			.45	3–4			.32	5	*Fe* II .49 (1)
4733							.97	1	[*Fe* I .59 (3) I B]
4736			.28	1			.89	1	*A* II 5.93 (15) *Fe* I .79 (5) II
4739			.72	2					*Mg* II .59 (5)
4742			.56	1					
4755			.81	2					*Mn* II .74 (2)
4762							.65	2	*Mn* I .38 30 III *C* I .41 (4) *Ti* II .77 (1)
4764							.23	3	*Ti* II? 3.90 [1] *Ti* II? .47 [1]
4765			.20	1:					*A* II 4.89 (10)

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4770....	....	....	....	....	....	....	.26	1	*C* I .00 (2)
4771....	....	....	....	....	....	....	.58	1	⊙ II .47 (3) *C* I .72 (4)
4774....	....	....	.83	1	....	....	....	....	....
4775....	....	....	....	....	....	....	.68	1	*C* I .87 (3)
4779....	....	....	.91	1	....	....	0.07	4	*Ti* II .99 (1)
4791....	....	....	.79	1	....	....	....	....	....
4783....	....	....	....	....	....	....	.17	2	*Mn* I .43 50 I
4785....	....	....	....	....	....	....	.71	1	[α Per .68? 1]
4788....	....	....	....	....	....	....	.21	1:	....
4792....	....	....	....	....	....	....	.13	1:n	....
4798....	....	....	....	....	....	....	.57	5	*Ti* II .52 [2]
4805....	....	....	....	....	....	....	.00	6	*Ti* II .11 (2)
4806....	....	....	.03	2–3	....	....	....	....	*A* II 6.07 (20)
4807....	....	....	....	....	....	....	.13	2	[*Ni* I .99 4 III]
4810....	....	....	....	....	....	....	.41	1	*Zn* I .53 (10R)
4812....	....	....	....	....	....	....	.11	2	*Cr* II .37 (2)
4815....	....	....	.54	2	....	....	....	....	*S* II .52 (9)
4817....	....	....	....	....	....	....	.11	1:	*C* I .33 (1)
4818....	....	....	....	....	....	....	.94	1:	....
4819....	....	....	.74	1	....	....	....	....	*S* II .55 (2)
4820....	....	....	....	....	....	....	.90	1:	*Ti* II 1.01 (pred)
4824....	....	....	.12	2	....	....	3.92	9	*Y* II 3.31 (30) *S* II .03 (3) *Cr* II .13 (10) *Mn* I .52 50 I
4826....	....	....	.72	1	....	....	....	....	....
4830....	....	....	.93	2	....	....	1.03	2	[*Ni* I 1.19 10 III]
4833....	....	....	....	....	....	....	.07	1	[*Ni* I 2.70 2 V]
4836....	....	....	.71	1	....	....	.38	4	*Cr* II .22 (2)
4839....	....	....	.53	1	....	....	.45	1:	*Ti* II .22 [1]

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4841....	....	....	....	....	....	....	.28	1:	....
4843....	....	....	.36	1	....	....	....	....	....
4845....	....	....	.25	2	....	....	....	....	....
4847....	....	....	.91	1	....	....	8.27	8	*A* II .78 (8) *Cr* II 8.27 (8)
4851....	....	....	.09	2	....	....	.50	1:	*Mg* II .10 (5)
4854....	....	....	....	....	....	....	.82	4	*Y* II .87 (150)
4855....	....	....	....	....	....	....	.93	4	*Ni* I .42 15 III *Cr* II 6.20 (1)
4861....	....	....	.20	6	....	....	.34	11	*H*β .33 (9)
4864....	....	....	.59	1	....	....	.31	7	*Cr* II .38 (3)
4865....	....	....	....	....	....	....	.85	4	*Ti* II .62 (tr) *Ni* I 6.28 10 III
4869....	....	....	....	....	....	....	.22	1:	....
4871....	....	....	....	....	....	....	.43	6	*Fe* I .33 (8) III *Fe* I 2.15 (6) III
4873....	....	....	....	....	....	....	.82	7	*Ti* II 4.03 (tr)
4876....	....	....	.38	2	....	....	.41	8	*Cr* II .42 (2) *Cr* II .50 (pred)
4883....	....	....	.50	1	....	....	.72	9n	*Y* II .69 (200)
4884....	....	....	.78	1	....	....	....	....	*Cr* II .61 (1)
4886....	....	....	....	....	....	....	.76	1:	....
4888....	....	....	....	....	....	....	.16	1:	....
4891....	....	....	....	....	....	....	.13	7	*Fe* I 0.77 (7) III *Fe* I .51 (9) III
4893....	....	....	....	....	....	....	.71	2	α Per .78 (4w) ⊙ II .82 (−1)
4895....	....	....	....	....	....	....	.37	1	....
4896....	....	....	.36	1	....	....	....	....	....
4898....	....	....	....	....	....	....	.74	2	....
4900....	....	....	....	....	....	....	.05	8	*Y* II .13 (150)
4901....	....	....	.52	2n	....	....	....	....	*Cr* II .62 (1)
4905....	....	....	....	....	....	....	.93	1:	....

TABLE III—*Continued*

λ	η Leo		υ Sgr		α Cyg		ε Aur		Identification
4907	....	....	.53	1	....	....	....	....	....
4909	....	....	....	....	....	....	.09	1:	....
4911	....	....	....	....	....	....	.33	9	*Ti* II .21 (0)
4920	....	....	....	....	....	....	.57	8	*Fe* I .52 (10) III
4921	....	....	.45	2	....	....	....	....	*He* I .93 (4)
4924	....	....	.21	4	....	....	3.82	10	*Fe* II 3.93 (10) *S* II .08 (4) *S* II 5.32 (5)
4942	....	....	.08	1	....	....	....	....	....
4948	....	....	.79	2	....	....	....	....	....
4952	....	....	.46	1n	....	....	....	....	....

The wave-lengths for the three peculiar stars α Andromedae (A0p), τ^9 Eridani (A0p), and φ Herculis (B9p) are given in Table IV. Several one-prism plates of excellent quality were measured of α Andromedae, but the wave-lengths in this star are the most unsatisfactory of any included in the present discussion. Baker[8] found that certain lines in this spectrum gave discordant velocities. The positions of rather well-defined lines differ by as much as 0.4 A on plates of the best quality. The spectrum is dominated by lines of singly ionized manganese. The star τ^9 Eridani is representative of the abnormal "silicon" group. All three stars in Table IV were measured on one-prism Process plates.

[8] *Pubs. Allegheny Obs.*, **1,** 17, 1910.

TABLE IV

WAVE-LENGTHS AND IDENTIFICATIONS IN PECULIAR STARS

λ	α And		τ^9 Eri		φ Her		Identification
3982	.63	1	.19	2	.74	5	*Ti* II .00 (tr) *Y* II .59 (150)
3984	.13	3	3.94	1:	.01	6	....
3986	.57	1	.09	1:	....	....	*Mn* II .01 (1)
3990	.46	1:	....	....	.11	2	....
3991	....	....	.84	1–2	.18	3	*Zr* II .14 (40)
3993	....	....	.86	1:	.78	1:	*S* II .49 (6) *Mn* II .86 (1)
3995	.24	1n	....	....	.38	2–3:	*N* II .00 (10)
3997	....	....	.94	2	.62	2–3	*Si* II 8.00 (1n)
3998	.78	1	....	....	.99	3	*Zr* II .97 (30)
4000	.33	1	9.50	1–2	9.96	2	*Mn* II .06 (1)
4000	....	....	....	....	.85	1	....
4002	.30	1	....	....	.02	2:	....
4003	....	....	....	....	.41	2:	*Cr* II .33 (2)
4005	.01	1:	.22	1:	.04	1:	*Fe* I .25 (7) II
4007	....	....	.86	1:	....	....	....
4008	....	....	.95	1	.77	1:	....
4009	.43	1:	.93	1–2	.66	2–3	*He* I .27 (1)
4010	....	....	....	....	.38	2	*Mn* II .84 (1)
4011	....	....	.34	1:	.78	1:	....
4012	.87	1	.54	3	.58	5	*Ti* II .37 (4)
4014	.74	1:	.00	1:	.49	1n	*Sc* II .49 (8)
4015	....	....	....	....	.54	1:	*Ni* II .50 (1)
4016	.14	1	....	....	....	....	....
4017	.80	1	....	....	....	....	....
4018	....	....	.31	1:	.43	1	*Zr* II .39 (10)
4019	.53	1:	....	....	....	....	....
4020	....	....	.69	1	.79	1	....
4022	.35	1n	.25	1	....	....	....

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4023	....	....	.36	1:	....	....	*V* II .38 (50)
4024	.64	1	.42	1	.46	1:	*Zr* II .44 (12)
4025	....	....	....	....	.27	2:	*Ti* II .13 (2)
4026	.39	2	.24	2	.57	4n	*He* I .19 (5) *He* I .36 (1)
4028	.64	1	.17	1:	.42	4n	*Ti* II .33 (7)
4029	....	....	....	....	.69	1	*Zr* II .68 (20)
4030	.73	1	.55	1:	.80	3–4	*Mn* I .76 200 I
4031	....	....	.63	1	2.04	2	*La* II .70 (300)
4032	.78	1n	.71	1	3.11	4	*S* II .77 (6) *Mn* I 3.07 150 I
4034	....	....	....	....	.47	1–2	*Mn* I .49 100 I
4035	.79	1:	....	....	....	....	....
4037	.07	1	....	....	6.84	1:	....
4037	....	....	.71	2–3	.97	2–3	*Cr* II 8.04 (2)
4038	.77	1	....	....	....	....	....
4039	.69	1	.62	1	.99	1n	*Zr* II 0.24 (4)
4041	.84	1	....	....	.33	1:	*Mn* I .37 50r I
4042	....	....	.54	1	.33	1	....
4043	....	....	.88	1:	4.18	1	....
4044	.60	1–2	....	....	5.16	1:	....
4046	.36	1	5.74	....	5.82	5	*Fe* I 5.82 (8R) II *Zr* II .62 (15)
4047	.20	1	....	....	.59	1	....
4048	.95	1n	.82	3	.91	4–5	*Zr* II .67 (25)
4050	.82	1:	1.00	1:	.58	1:	*Zr* II .33 (15)
4052	.48	1n?	....	....	.13	4	*Cr* II .00 (1)
4053	....	....	.13	1	....	....	*Cr* II .45 (pred)
4054	.41	1	.06	1	3.97	5	*Ti* II 3.81 (3) *Cr* II .09 (pred)

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4055.......	....	....	.13	1	.44	1–2	*Mn* I .55 20 I
4057.......	....	....	.28	1–2	....	....	*Mg* I .51 (5r)
4058.......	.69	1n	....	....	....	....	....
4059.......	....	....	.10	1:	.50	1	....
4060.......	....	....	.36	1:	....	....	....
4063.......	....	....	.62	1	.54	1	*Fe* I .60 (8R) II
4064.......	.77	1	....	....	....	....	....
4065.......	....	....	.37	1	....	....	....
4066.......	.98	1	....	....	7.16	1:	*Ni* II 7.04 (3)
4068.......	.85	1	.73	1:	....	....	....
4069.......	....	....	.83	1:	....	....	....
4070.......	....	....	.80	1:	.86	1	*Cr* II .99 (2)
4071.......	.73	1:	.92	1:	....	....	*Fe* I .75 (7R) II
4073.......	....	....	.35	1:n	.23	1:	....
4075.......	....	....	.48	3	.35	1	*Si* II .45 (2)
4076.......	....	....	.73	3	.84	1	*Si* II .78 (1)
4077.......	.39	1:	.67	2	.79	3–4	*Sr* II .71 400r
4078.......	.41	1	....	....	....	....	....
4079.......	.35	1	....	....	....	....	....
4080.......	....	....	.06	1	.23	1:	....
4081.......	....	....	....	....	.16	1–2	....
4081.......	.66	1	2.05	1:	.63	1:	....
4083.......	.40	1	4.20	1:	.63	1:	....
4085.......	.33	1	.83	1	.14	1	....
4087.......	.93	1	.35	1	.38	1	*Fe* II .27 (*)
4089.......	....	....	.40	1:	.56	1	....
4090.......	.27	1n	1.13	1	.75	1	*Zr* II .52 (10)
4091.......	....	....	....	....	.55	1	....

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4094.......	.89	1n	....	....	.31	3	....
4095.......	....	....	....	....	.16	1–2	....
4096.......	.66	1	....	....	.22	1:	....
4098.......	.87	1?	....	....	9.23	3:	....
4101.......	.76	50	.73	50	.71	50	*H*δ .74 (7)
4103.......	.61	2?	....	....	....	....	....
4104.......	....	....	....	....	.26	2:	....
4105.......	.00	1	....	....	....	....	*Mn* II .01 (2)
4106.......	.79	2	....	....	.76	3	....
4107.......	.98	1:	....	....	....	....	....
4108.......	.54	1:	.04	1:	.30	1–2	....
4109.......	....	....	.37	1:	.36	1	....
4110.......	.66	1	....	....	.30	1:	....
4110.......	....	....	.98	1	1.09	5	*Cr* II 1.04 (2)
4113.......	.70	1	.03	1	.29	2	*Cr* II .29 (1)
4116.......	.28	1:	....	....	.16	1:	....
4118.......	....	....	.47	1	.51	1:	*Fe* I .56 (6) IV
4119.......	....	....	.59	1	.81	1:	....
4120.......	.99	1	.89	1:	.98	1:	*He* I .81 (3) *He* I .98 (1)
4122.......	.98	1	.68	1	.65	1	*Fe* II .67 (*)
4124.......	....	....	.91	1	.81	3	*Y* II .91 (15)
4125.......	.71	1	....	....	6.06	1:	*Mn* II .86 (1)
4126.......	....	....	....	....	.96	2	....
4128.......	.05	5	.00	8	.02	7	*Si* II .05 (8) *Fe* II .73 (*)
4129.......	....	....	.58	1	.31	1	....
4130.......	.90	4	.85	8	.92	7	*Si* II .88 (10)
4132.......	....	....	.42	1	.58	2	*Mn* II .28 (1) *Cr* II .45 (1)
4133.......	.68	1	.70	1:	.65	1	....

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4134	....	....	....	....	.74	1	....
4137	.01	3	.22	1:	6.80	3	*Mn* II 6.91 (2)
4138	....	....	.41	1	.05	1	*Fe* II .37 (*)
4139	....	....	....	....	.04	1:	....
4140	.66	2	....	....	.57	1:	....
4142	....	....	.11	1	....	....	*S* II .24 (8)
4143	.9	1n	.52	2	.96	1–2	*He* I .77 (2) *Fe* I .87 (7) I
4145	....	....	.81	1	.82	2	*Cr* II .81 (3)
4147	....	....	.12	1:	6.89	1	*S* II 6.90 (5)
4147	....	....	....	....	.67	1	....
4148	....	....	.70	1	9.12	2	*Zr* II 9.21 (75)
4150	....	....	.36	2	.14	2n	....
4152	....	....	.01	1:	....	....	*La* II 1.95 (250)
4153	....	....	.27	1:	.17	1:	*S* II .05 (10)
4154	....	....	....	....	.48	1	*Cr* II .29 (pred)
4155	....	....	.09	1:	....	....	....
4156	....	....	....	....	.58	1–2	*Zr* II .24 (15)
4158	....	....	.90	1	.65	1:	....
4159	....	....	....	....	.47	1	....
4160	....	....	.67	1	....	....	....
4161	....	....	.76	1–2	.16	2–3	*Zr* II .21 (20) *Ti* II .52 (1) *Sr* II .81 30
4162	....	....	.88	1–2	3.00	1:	*S* II .64 (10)
4163	....	....	....	....	.54	3	*Ti* II .65 (40)
4164	....	....	.84	1:	5.08	1	*S* II .98 (2) *S* II 5.20 (3)
4165	....	....	.93	1	6.39	1:	....
4167	....	....	.17	1–2	.01	1–2	*Mg* I .27 10n III?

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4168.......	....	....	.84	1:	9.11	1:	*S* II .37 (5) *He* I .97 (1)
4170.......	....	....	.71	1:	.88	1	*Cr* II .65 (pred)
4171.......	.54	2	.89	1	2.04	5	*Ti* II .90 (30)
4173.......	.91	1n	.67	1–2	.45	4	*Fe* II .48 (6) *Ti* II .54 (1) *S* II .97 (4)
4174.......	....	....	....	....	.54	2	....
4175.......	....	....	.83	1	.70	1–2	*Fe* I .64 (4) III
4176.......	.35	1	.66	1:	....	....	....
4178.......	.31	2n	7.85	1	7.52	6	*Y* II 7.54 (125)
4179.......	....	....	.01	1–2	8.91	4	*Fe* II 8.87 (6) *Cr* II .41 (2)
4180.......	....	....	.88	1	....	....	....
4182.......	....	....	.03	1	1.87	1	....
4183.......	....	....	.22	1:	.02	1	*V* II .43 (35)
4184.......	.65	1	.59	1:	.30	2	*Ti* II .33 (0)
4185.......	....	....	....	....	.55	1	....
4186.......	....	....	....	....	.68	1	....
4187.......	....	....	.46	2	.61	1	*Fe* I .81 (6) III
4189.......	....	....	.10	1	8.79	1:	....
4190.......	....	....	.69	2–3	.58	1	*Ti* II .29 [1] *Si* II .74 (3)
4192.......	....	....	.74	1:	3.04	1	....
4195.......	....	....	.98	1n:	.08	1–2	....
4196.......	....	....	....	....	.64	1	....
4198.......	....	....	.18	1	.19	1:	*Si* II .17 (2) *Fe* I .31 (6) III
4199.......	....	....	.67	1	.26	1	*Fe* I .10 (6) III *Y* II .28 (5)
4200.......	.39	2	.93	3	.79	1	*Mn* II .25 (2)
4202.......	....	....	.17	1	.00	2	*Fe* I .03 (7R) I *V* II .35 (35)

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4202.......	.77	1	....	....	....	....	....
4203.......	....	....	.23	1	.46	1	....
4204.......	....	....	.13	1	.62	1	*Y* II .69 (10)
4205.......	....	....	.22	1:	.47	3	*Mn* II? .47 (1)
4206.......	.23	3v?	.58	1:	.40	3	*Mn* II .43 (2)
4207.......	....	....	.66	1	.26	1:	*Cr* II .34 (pred)
4208.......	....	....	....	....	.84	2	*Zr* II .98 (30)
4210.......	....	....	.54	1n	.38	1:	*Fe* I .36 (6) III
4211.......	....	....	....	....	.94	1:	*Zr* II .88 (12)
4212.......	....	....	.85	1n:	....	....	....
4213.......	....	....	....	....	.72	1:	....
4215.......	....	....	.53	1	.43	2	*Sr* II .52 300r *Cr* II .78 (pred)
4217.......	....	....	....	....	.05	1:	*Cr* II .09 (pred) *S* II .19 (4)
4219.......	....	....	.21	1	.64	1:	*Fe* I .36 (5) IV
4221.......	....	....	.15	1:	.44	1:	....
4222.......	....	....	....	....	.30	1	*Fe* I .23 (5) III
4224.......	....	....	.93	1	.77	1	*Cr* II .85 (2)
4227.......	....	....	.56	1:	.15	1:	*Ca* I 6.73 500 I *Fe* I .45 (7) III
4229.......	....	....	.95	1	....	....	*Cr* II .82 (pred)
4231.......	....	....	.60	1:	.31	1:	....
4233.......	.13	2	.22	4	.18	7	*Fe* II .16 (8) *Cr* II .25 (1)
4235.......	....	....	.25	1	.79	3	*Y* II .73 (20)
4238.......	.81	2n	.85	1	.99	2–3	*Fe* I .82 (4) IV
4240.......	.82	1:	....	....	.81	1	....
4242.......	.60	2	.49	2	.34	6	*Mn* II .35 (2) *Cr* II .35 (5)
4244.......	.63	1	.86	1	.23	2	*Mn* II .26 (1) *Ni* II .80 (1)

TABLE IV—*Continued*

λ	α And		τ⁹ Eri		φ Her		Identification
4245.......	....	....	....	....	.60	1:	....
4246.......	.16	1:	.45	1	.68	2–3	*Sc* II .83 (100)
4247.......	.84	1	8.10	1	....	....	*Mn* II .95 (1)
4248.......	....	....	....	....	.41	1	....
4250.......	....	....	.93	1:	.67	1	*Fe* I .13 (7) III *Fe* I .79 (8) II
4251.......	.30	1	....	....	.47	2	*Mn* II .77 (2)
4253.......	.20	2	2.65	1	2.88	5	*Mn* II .02 (2)
4254.......	....	....	.67	1	.59	2	*Cr* I .34 (1000) II
4255.......	.80	2	6.29	1	6.20	1:	....
4258.......	....	....	.08	1	7.60	1:	*Zr* II .05 (12) *Fe* II .14 (*)
4259.......	.25	2	.30	1:	....	....	*Mn* II .26 (2)
4260.......	....	....	.46	1:	.44	1n	*Fe* I .49 (10) III
4262.......	.08	1	.02	1–2	1.83	4	*Cr* II 1.81 (pred) *Cr* II 1.91 (2)
4262.......	....	....	....	....	.86	1	....
4263.......	....	....	.89	1	.91	1–2	....
4265.......	....	....	.44	1	.77	1:	....
4267.......	.43	2	.41	2n	6.99	1–2n	*S* II 6.90 (4) *C* II .02 (8) *S* II .27 (4) *C* II .27 (10)
4269.......	....	....	.35	1–2n	8.96	2n	*S* II 8.76 (6) *Cr* II .30 (1)
4271.......	....	....	.51	1	.51	3	*Fe* I .17 (7) III *Fe* I .76 (8R) II
4273.......	.01	1	.37	1	.42	2–3	*Fe* II .31 (1)
4274.......	....	....	....	....	.58	2	*Cr* I .80 (300) II
4275.......	.59	1	.55	1	.58	3	*Cr* II .56 (1)
4277.......	....	....	....	....	.24	1:	....
4278.......	.49	1	.08	1	.59	1:	*Fe* II .13 (1) *S* II .51 (4)

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4282	.27	3	.02	1:	.23	3	*Zr* II .20 (6) *Fe* I .41 (6) III *Mn* II .50 (3)
4283	....	....	....	....	.75	2	*Mn* II .84 (1)
4284	.37	1	.08	2	.29	3	*Cr* II .24 (2)
4286	....	....	....	....	.09	1n	....
4287	.88	1	.97	1	.80	2n	*Ti* II .89 (2)
4290	....	....	.19	1	9.89	4n	*Cr* I 9.72 (350) *Ti* II .22 (50)
4292	.42	2	1.67	1	.11	3	*Mn* II .28 (2)
4293	....	....	.18	1	....	....	....
4294	....	....	.15	1	.02	3–4	*Ti* II .10 (40) *Fe* I .13 (6) II *S* II .39 (6)
4297	.01	1	6.68	2	6.56	3–4	*Fe* II .56 (6)
4298	....	....	.25	1	.46	1:n	....
4300	.53	1	.22	2n	.03	4–5	*Ti* II .05 (60) *Mn* II .24 (1)
4301	....	....	.80	1:	.85	2n	*Ti* II .93 (15)
4303	.18	2	.17	2–3	.15	3	*Fe* II .18 (4)
4304	....	....	....	....	.04	1	....
4305	....	....	....	....	.80	1:n	*Sc* II .71 (6)
4306	....	....	.36	1	....	....	....
4307	....	....	....	....	.15	1	....
4308	.32	2	.42	1	7.98	4	*Ti* II 7.86 (40) *Fe* I 7.91 (8R) II
4309	....	....	....	....	.68	2–3	*Y* II .62 (50)
4310	.45	1	....	....	....	....	....
4311	....	....	....	....	.33	1:	....
4312	....	....	.56	1	.88	3	*Ti* II .87 (35)
4314	....	....	.79	1–2	.27	3	*Sc* II .09 (30)
4314	....	....	....	....	.98	3	*Ti* II .98 (40) *Fe* I 5.09 (5) III

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4317	....	....	.02	1	6.79	1	*Ti* II 6.81 (1)
4318	....	....	.69	1:	.47	1:	*S* II .64 (4)
4319	....	....	.68	1:	.64	1:	....
4320	....	....	....	....	.70	3–4	*Sc* II .73 (20) *Ti* II .97 (1)
4321	....	....	.62	1	....	....	....
4322	....	....	....	....	.56	1	*La* II .51 150 III
4324	.91	1	5.55	2n	5.21	3n	*Sc* II 5.00 (20) *Fe* I 5.77 (9R) II
4326	.75	2	.98	1:	.72	2	*Mn* II .71 (3)
4330	....	....	....	....	.67	2:	*Ti* II .26 (0) *Ti* II .71 (0)
4338	....	....	.47	1:	.23	3:	*Ti* II 7.92 (50)
4340	.47	50	.65	50	.47	50	*H*γ .47 (8)
4341	....	....	....	....	.98	3:	
4342	....	....	.82	1:	.93	1:	
4344	.01	1	3.89	1:	.40	4	*Mn* II .03 (1) *Ti* II .29 (2) *Cr* I .51 (40) II
4346	.12	1	5.84	1:	.39	1	....
4348	.54	1	.59	1:	.61	2	*Mn* II .49 (1)
4350	....	....	.05	1:	.31	1:	*Ti* II .86 (1)
4351	.67	1	2.08	2	.81	4	*Fe* II .77 (6) *Cr* I .77 (60) I
4354	....	....	.32	1	.08	1	*Sc* II .60 (5)
4356	.90	1	....	....	.51	1:	....
4357	....	....	.68	1	.58	1	....
4358	....	....	....	....	.72	2	*Y* II .73 (30)
4359	....	....	.60	1:	.83	1	*Zr* II .74 (10)
4361	....	....	.14	1:	....	....	....
4362	.94	1	....	....	.47	1n	*Ni* II .10 (1)
4365	.65	1	.89	1:	.58	1–2	*Mn* II .29 (1)

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4368	...	...	.05	1:	7.93	3	*Ti* II 7.66 (15)
4369	...	...	.44	1:	.44	2	*Fe* II .40 (*)
4370	...	...	...	...	.88	2	*Zr* II .95 (8)
4372	...	...	.81	1:	.78	1	...
4374	...	...	.76	1	.86	4–5	*Sc* II .46 (30) *Ti* II .83 (1) *Y* II .94 (300)
4377	...	...	.17	3–4	...	...	...
4377	.91	1	...	...	.61	1n	...
4380	.08	1	.46	1	9.64	2	*Zr* II 9.77 (9)
4381	...	...	...	...	.70	1	...
4384	...	...	.06	1	3.46	2	*Fe* I 3.55 (10R) II
4385	.54	1	.33	1	.13	2	*Mg* II 4.64 (8) *Sc* II 4.80 (5) *Fe* II .39 (*)
4387	...	...	...	...	.01	1	*Ti* II .86 (10)
4388	.23	1	.13	1:	.47	1:	*He* I 7.93 (3)
4390	...	...	.78	1:	.54	2	*Mg* II .59 (10) *Ti* II .98 (tr)
4393	.46	1	.32	1	.67	1	*Ti* II 4.06 (2)
4395	.55	1	.58	1–2	4.99	2	*Ti* II .04 (60)
4396	...	...	...	...	.05	1	*Ti* II 5.85 (2)
4398	...	...	.32	1:	.14	3	*Y* II .02 (50) *Ti* II .32 [1]
4399	...	...	.97	1:	0.25	3–4	*Ti* II .77 (35) *Sc* II 0.38 (20)
4401	...	...	.52	1:	.37	1	*Ni* I .55 30 III
4403	.59	1:	2.76	1	.33	2	...
4404	...	...	.86	1	5.18	2	*Fe* I .75 (8R) II
4407	...	...	...	...	.89	1	*Ti* II .67 (1)
4409	...	...	.68	1:	.08	1	*Ti* II .25 (tr) *Ti* II .54 (tr)
4411	...	...	.47	1:	.15	1	*Ti* II .08 (15)

TABLE IV—*Continued*

λ	α And		τ⁹ Eri		φ Her		Identification
4414	......	......	.07	1:	.03	1:	......
4415	......	......	......	......	.08	1–2	*Fe* II .13 (8R) II *Sc* II .56 (20)
4416	......	......	.86	1	.86	2	*Fe* II .81 (4)
4417	.31	1	......	......	.95	1	*Ti* II .72 (40) *Ti* II 8.34 (1)
4418	......	......	.99	1	......	......	......
4420	.77	1	......	......	.67	1:	......
4422	......	......	.26	1:	.66	1	*Y* II .59 (40)
4425	......	......	......	......	.11	1	......
4428	......	......	......	......	.00	1:	*Mg* II .00 (7)
4431	......	......	.40	1	......	......	......
4434	.01	1	......	......	3.81	1	*Mg* II 3.99 (8)
4434	......	......	.61	1	......	......	......
4436	......	......	......	......	.76	1:	*Mg* II .48 (5)
4442	......	......	.09	1:	1.73	1:	*Ti* II 1.73 (pred)
4442	......	......	......	......	.94	1:	*Zr* II .99 (25)
4443	.75	1:n	4.18	1–2n	.95	2n	*Ti* II .80 (50) *Ti* II 4.56 (1)
4446	......	......	.39	1	......	......	......
4447	......	......	.84	1	.73	1	*Fe* I .73 (5) III
4449	......	......	.13	1	......	......	......
4450	......	......	.77	1:	.62	1	*Ti* II .49 (10)
4452	.15	1	1.64	1	.10	1:	......
4455	......	......	.06	1	4.91	1	*Zr* II 4.80 (10)
4455	......	......	......	......	.81	1	......
4456	......	......	.77	1	......	......	......
4458	......	......	......	......	.80	1	*Ni* I 9.05 20 III *Fe* I 9.13 (5) III
4461	......	......	.77	1–2	2.05	1	*Mn* I 2.03 20 III
4462	.61	1	......	......	......	......	......

TABLE IV—*Continued*

λ	α And		τ⁴ Eri		φ Her		Identification
4464	...	...	...	...	.66	1:	*Ti* II .46 (1)
4466	...	...	...	...	.94	1:	*Fe* I .56 (5) II
4468	.39	1	.33	1	.43	2–3	*Ti* II .49 (50) *Ti* II 9.15 (tr)
4471	.78	2	.63	1–2	.45	2	*He* I .48 (6) *He* I .69 (1)
4473	...	...	.25	1	...	...	*Fe* II 2.91 (*)
4475	.54	1	...	...	...	...	...
4478	.97	1–2	...	...	9.66	1	*Mn* II .74 (1)
4481	.33	5	.28	5	.22	8	*Mg* II $\left\{\begin{matrix}.13\\.33\end{matrix}\right\}$ (100)
4483	...	...	.87	1:	.07	1	*S* II .42 (6)
4487	...	...	...	...	.24	1	...
4488	...	...	...	...	.28	1–2	*Ti* II .32 (15)
4489	...	...	.23	1	.87	1	*Fe* II .21 (4)
4491	...	...	.34	1	.39	1	*Fe* II .41 (4)
4493	...	...	.68	1	.10	1	*Ti* II .54 [1]
4494	...	...	...	...	.70	1n	*Zr* II .41 (8) *Fe* I .57 (5) III
4496	...	...	...	...	.92	1	*Zr* II .97 (15)
4497	...	...	...	...	.82	1	...
4499	...	...	...	...	.73	1	...
4501	...	...	.45	1	.31	3	*Ti* II .27 (40)
4503	...	...	.15	1	.77	1	...
4504	...	...	.88	1	5.47	1	...
4508	.78	1:	.22	1–2	.32	2	*Fe* II .29 (8)
4509	...	...	.86	1:	0.69	1	...
4511	...	...	.96	1–2	2.34	1	...
4513	...	...	...	...	.29	1	...
4514	...	...	.49	1:	.11	1:	...
4515	.28	1	.43	2	.58	1	*Fe* II .34 (6)

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4518.......	....	....	....	....	.24	1	....
4519.......	.72	1–2	0.15	2	0.74	2	*Fe* II 0.24 (6)
4522.......	.78	1	.90	2	.68	3–4	*Fe* II .64 (6)
4525.......	.53	1	....	....	.76	1n	....
4526.......	....	....	.68	1	....	....	....
4528.......	....	....	.54	1–2	....	....	*Fe* I .62 (7) II
4529.......	....	....	.49	1–2	.40	1:	*Ti* II .51 (1)
4530.......	.19	1:	....	....	....	....	....
4534.......	.24	1n?	.11	1	.13	3	*Ti* II 3.97 (30) *Fe* II .18 (*) *Mg* II .26 (4)
4539.......	....	....	....	....	.47	1	....
4541.......	....	....	.41	1	.76	1	*Fe* II .33 (1) *Fe* II .53 (*)
4544.......	....	....	.02	1:	.39	1	*Ti* II .03 (tr) *Cr* II .69 (pred)
4547.......	....	....	....	....	.11	1	....
4549.......	.50	3	.45	3	.63	6	*Fe* II .48 (4) *Ti* II .62 (60)
4551.......	....	....	.14	1	....	....	....
4552.......	....	....	.78	1	.42	1	*Ti* II .25 (pred) *S* II .37 (5) *Si* III .61 (9)
4554.......	....	....	....	....	.28	2	*Zr* II 3.96 (12) *Ba* II .04 1000R
4555.......	.61	1	4.70 .87	1–2 2	.27	2–3n	*Cr* II .00 (2) *Fe* II .90 (6)
4556.......	....	....	....	....	.45	2	....
4557.......	....	....	....	....	.71	1	....
4558.......	.61	1	.84	2–3	.67	4–5	*Cr* II .66 (20) *Cr* II .78 (pred)
4560.......	....	....	....	....	.20	1	....
4561.......	....	....	....	....	.51	1	....
4564.......	....	....	.05	1	3.59	2–3	*Ti* II 3.76 (30)

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4565	....	....	.70	1	.86	1–2	*Cr* II .78 (2)
4568	....	....	.06	1:	7.89	1:	*Si* III 7.83 (7) *Ti* II .31 [1]
4570	....	....	.11	1:	9.56	1	....
4571	....	....	....	....	.07	1	*Mg* I .11 5 IA *Cr* II .30 (pred)
4571	....	....	.82	1:	2.00	2–3	*Ti* II .97 (50)
4574	....	....	....	....	.43	1	*Si* III .75 (4)
4576	....	....	.37	1	.33	2	*Fe* II .31 (4)
4578	....	....	....	....	.69	1	....
4579	....	....	.66	1–2	....	....	....
4580	....	....	....	....	.60	1	*Ti* II .47 [1]
4582	....	....	.85	1	.42	1–2	*Fe* II .43 (*)
4583	.68	1	.74	2–3	4.02	2–3n	*Fe* II 4.84 (8)
4586	....	....	....	....	.86	2	....
4588	.26	2	.36	1–2	.24	2	*Cr* II .21 (20)
4590	....	....	....	....	.21	2	*Cr* II 9.94 (1) *Ti* II 9.96 (2)
4592	....	....	....	....	.22	3	*Cr* II .06 (2)
4593	....	....	....	....	.87	1	....
4596	....	....	.19	1	.04	1	*Fe* II 5.69 (*)
4597	....	....	....	....	.66	1	....
4598	....	....	.56	1	....	....	....
4599	....	....	....	....	.43	1	....
4601	.95	2	.34	1	.38	1n	*Fe* II .38 (*) *N* II .49 (8)
4603	....	....	....	....	.91	1	....
4605	....	....	.44	1	.37	1–2	....
4607	....	....	.87	1:	.90	1	....
4609	....	....	....	....	.75	2	....
4611	....	....	.36	1:	.79	1	....

TABLE IV—*Continued*

λ	α And		τ^9 Eri		φ Her		Identification
4613	....	....	....	....	.56	2	....
4614	....	....	....	....	.74	2:	....
4616	....	....	.47	1	.42	2–3	*Cr* II .67 (3)
4618	....	....	.73	2	.77	2–3	*Cr* II .82 (10)
4620	....	....	.13	1	.82	1–2	*Fe* II .52 (*)
4621	....	....	.48	3	....	....	....
4622	....	....	....	....	.50	2	....
4624	....	....	.11	1:	.86	1	....
4627	.47	2	....	....	....	....	....
4629	....	....	.02	1n	.36	3	*Fe* II .33 (4)
4631	....	....	.59	1:	.77	2	....
4634	....	....	.29	1	3.95	3	*Cr* II .09 (10)
4638	.00	3	7.87	1–2	....	....	....
4640	....	....	.11	1	....	....	....
4642	....	....	.13	1	....	....	....
4646	....	....	.92	1	....	....	....
4648	....	....	.91	1:	....	....	....
4656	....	....	.95	1–2	....	....	*Fe* II 7.01
4663	....	....	.18	1	....	....	....
4665	....	....	.89	1	....	....	....
4670	....	....	.16	1	....	....	*Sc* II .40 (10)
4673	....	....	.20	1–2n	....	....	....

Table V includes the additional peculiar stars θ Aurigae (A0p), α^2 Canum Venaticorum (A0p), and β Coronae Borealis (F0p). The first of these stars has a variable spectrum which has not been investigated as yet. The last two are especially remarkable for the strength of the lines of singly ionized europium. A number of investigations of the spectrum of α^2 Canum Venaticorum have been made, but it is still one of the most promising objects for further study. In spite of the fact that the effective excitation is quite high (*Fe* I is only doubtfully present), the spectrum is crowded with lines which vary in intensity. The wave-lengths in this spectrum were measured at a phase when the lines of *Eu* II had their maximum intensity. The spectrum is too complex for a dispersion of one prism and the present identifications are very incomplete. The rare earths *Dy* II, *Gd* II, and *Eu* II are quite strong. Kiess,[9] from a study of plates of higher dispersion, identified a number of strong variable stellar lines with *Tb* II. This identification could not be verified on Yerkes plates. The star is not included in the summary of the behavior of the elements in Table VI because of the unsatisfactory state of the identifications. A detailed high-dispersion study of α^2 Canum Venaticorum and υ Sagittarii could not fail to bring to light new peculiarities and might well result in the identification of astrophysically unobserved elements. The star 73 Draconis, which has been previously investigated,[10] fills the gap between α^2 Canum Venaticorum and β Coronae Borealis. The latter star shares with γ Equulei the peculiarity of having abnormal relative intensities for the lines of *Fe* I. The spectra of both stars are too complex for adequate discussion from one-prism plates and β Coronae Borealis is included here only to show the transition between the A- and F-type peculiar stars.

[9] *Pubs. University of Michigan Obs.*, **3**, 108, 1919.

[10] *Ap. J.*, **77**, 77, 1933.

TABLE V

WAVE-LENGTHS AND IDENTIFICATIONS IN PECULIAR STARS—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
3913			.42	3			*Ti* II .46 (60)
3914	.54	1	.12	2n			*V* II .33 (20)
3915			.37	2n			
3916	.77	1:	.64	3			*Gd* II .58 300
3918			.40	3n			*C* II .98 (6)
3919	.46	1n	.34	2			*Cr* I .16 35n II
3920	.68	1	.29	2n			*Fe* I .26 (6R) I *C* II .68 (8) *Cr* I 1.02 (20) I
3922	.41	1	1.76	3n			
3923			.26	4n			*Fe* I 2.92 (6R) I
3924	.50	1					
3925			.07	2n			
3925	.96	1–2					
3927	.04	1:					
3928	.19	1	7.79	3n			*Fe* I 7.93 (6R) I
3930	.09	1	.48	8			*Fe* I .30 (7R) I *Eu* II .50 300R *Y* II .67 (15)
3930	.84	1–2					
3933	.67	3	.61	6			*Ca* II .67 (10)
3934			.89	2			
3935	.97	1	.92	3			*Fe* I .82 (4) III
3936			.87	2			
3937	.96	1	8.06	5			*Mg* I 8.43 (3r)
3938	.81	1	.87	5			
3940			.30	1			*Fe* I .89 (4) II?
3941	.46	1					*Fe* I .29 (2) *Cr* I .49 20
3942			.17	1			
3942			.68	1			*Fe* I .45 (3) IV
3943	.87	1	.76	1n			*Mn* II .81 (1) *Al* I 4.03 (10R)

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
3945.......	.23	1	4.81	4n	....	....	*Dy* II .69 600
3946.......	.96	1:	.91	2	....	....	*O* I 7.33 (10)
3948.......	.29	1	.02	1n	....	....	*O* I 7.51 (7) *O* I 7.61 (4)
3948.......	....	....	.58	2	....	....	....
3950.......	....	....	.37	4	....	....	*Y* II .35 (200)
3950.......	.86	1	....	....	....	....	....
3952.......	.62	1	.40	1n	....	....	*V* II 1.97 (40)
3954.......	.50	1–2	.41	3n	....	....	....
3955.......	....	....	.39	1	....	....	....
3956.......	.99	1:	.62	1n	....	....	*Fe* I .68 (6) III
3957.......	....	....	.87	4n	....	....	*Gd* II .69 150 *Zr* II 8.23 (50)
3959.......	....	....	.52	3	....	....	....
3960.......	.90	1	.72	2	....	....	....
3961.......	....	....	.66	1	....	....	*Al* I .54 (10R)
3963.......	....	....	.25	2n	....	....	*Cr* I .69 30 II
3964.......	.13	1n	....	....	....	....	....
3966.......	....	....	.22	1n	....	....	....
3968.......	.45	2:	.37	6	....	....	*Dy* II .39 1000 *Ca* II .46 (10)
3970.......	.00	40	.02	30	....	....	*Hε* .08 (6)
3974.......	.31	1	....	....	....	....	*Fe* II .17 (*)
3974.......	....	....	.93	1	....	....	....
3976.......	.60	1	....	....	....	....	*Cr* I .67 25 II
3977.......	....	....	.35	1	....	....	....
3978.......	....	....	.46	3	....	....	*Dy* II .56 150
3979.......	....	....	.39	3	....	....	*Cr* II .21 (pred)
3980.......	.03	2	....	....	....	....	....
3980.......	....	....	.71	1	....	....	....
3982.......	.13	1	.02	3	....	....	*Ti* II .00 (tr) *Y* II .59 (150)

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
3984	.38	1	.00	5	...	...	*Dy* II 3.66 100 *Cr* I 3.91 20 II
3985	...	...	.97	1n	...	...	...
3986	.49	1	...	...	...	...	...
3987	...	...	.46	1n	...	...	...
3989	...	...	.57				
3990	.33	1:	...	2nn			
3991	.71	1n	...	...	...	...	*Zr* II .14 (40)
3992	...	...	.28	...	...	...	...
3994	.46	1	3.88	1n	...	...	...
3996	...	...	.57	1	...	...	*Dy* II .69 200
3997	.86	1n	.90	1n	...	...	*Si* II 8.00 (1n)
3998	...	...	.98	2	...	...	*Zr* II .97 (30)
4000	.21	1:	.51	2	...	...	*Mn* II .06 (1) *Dy* II .45 600
4002	.16	1:	.28	2	...	...	...
4003	.03	3n	2.94	2	...	...	*V* II 2.95 (10)
4005	.27	1	.35	2n	.02	6	*Fe* I .25 (7) II *V* II .71 (60)
4006	...	...	...	...	.46	1–2	*Fe* I .16 (*) *Fe* I .31 (2) IV
4007	...	...	.01	1n	...	...	*Fe* I .27 (3) IV
4008	.03	1	7.98	1	.57	1	*Fe* I 7.61 (⊙ –1)
4008	...	...	...	...	.98	2	*Fe* I .85 [⊙ 2] *Fe* I .88 (⊙ 2) *Ti* I .92 35 II
4009	...	...	.05	1n	.69	1	*Ti* I .65 15 II *Fe* I .71 (5) III
4010	...	...	...	...	.71	1–2	⊙ II .59 (3) *Fe* I .77 [⊙ 2] *Fe* I .95 (1)
4011	...	...	...	...	.65	1:	*Fe* I .42 (1) *Fe* I .72 (⊙ 2)
4012	.82	3	.39	7	.40	3	*Ti* II .37 (4)

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4013	.....	.....	.....	.....	.73	1–2	*Ti* I .58 12n III *Fe* I .64 (1) *Fe* I .80 (2) V
4014	.....	.....	.42	2n	.59	1–2	*Fe* I .54 (4) III
4015	.....	.....	.68	1	.81	1–2	*Ni* II .50 (1) ⊙ (1)? .61 (3–3)
4016	.96	1:	.36	1n	.....	.....	.....
4017	.....	.....	.....	.....	.54	1–2	*Fe* I .10 (1) *Fe* I .15 (3) III
4018	.22	1–2	.19	1	.13	2	*Fe* I .11 (2) *Mn* I .11 20 I *Fe* I .28 (2) *Zr* II .39 (10)
4019	.....	.....	.50	2n	.23	1	.....
4020	.....	.....	.86	2	.30	1	*Fe* I .49 (1)
4022	.....	.....	.13	3n	.02	1	*Fe* I 1.87 (5) III
4022	.63	1	.....	.....	.41	1	*Fe* I .73 (⊙ 2)
4023	.....	.....	.....	.....	.67	1	*V* II .38 (50)
4024	.64	1 }	.....	.....	{ .78	3	*Zr* II .44 (12) *Ti* I .56 35 II *Fe* I .75 (2) V *Ti* II 5.13 (2)
4025	.....	.....	.76	3nn			
4026	.32	1: }	.....	.....	{ .40	1	*He* I .19 (5) *He* I .36 (1) *Fe* I .44 (1)
4028	.69	1	.14	4n	.32	2	*Ti* II .33 (7)
4029	.....	.....	.77	2n	.72	1–2	*Fe* I .64 (2) V *Zr* II .68 (20)
4030	.72	2	.....	.....	.68	4	*Cr* II .37 (pred) *Fe* I .51 (3) IV *Mn* I .76 200 I
4031	.....	.....	.43	1	.56	1	*Fe* I .24 (1) *Mn* I .80 (4) *Fe* I .97 (2) V
4033	.16	1–2	2.77	2	.01	3–4	*Fe* I 2.64 (1) III *Mn* I .07 150 I
4033	.....	.....	.95	3n	4.64	1	*Mn* I 4.49 100 I

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4035	.....	.....	.09	1	.....	.....	.....
4036	.17	1:	.16	3	5.81	2	*Mn* I 5.73 15 I
4037	.....	.....	.30	2	.59	1	*Gd* II .34 200 *Fe* I .73 (1)
4038	.26	1–2	7.94	2	.....	.....	*Gd* II 7.90 125 *Cr* II .04 (2)
4039	.....	.....	.59	1	.11	1:	*Fe* I 8.82 (1)
4040	.....	.....	.....	.....	.07	1:	*Fe* I .10 (⊙ 2)
4040	.....	.....	.60	?	.89	1	*Fe* I .65 (1) V
4041	.49	1	.....	.....	.61	1	*Fe* I .29 (1) *Mn* I .37 50r I
4042	.....	.....	.27	1	.82	1	.....
4043	.....	.....	.08	1n	.....	.....	.....
4044	.01	1	3.68	1	3.92	2	*Fe* I 3.90 (2) IV *Fe* I 3.99 (⊙ 2)
4044	.....	.....	.....	.....	.79	1	*Fe* I .62 (2) IV
4045	.86	1	.40	3	.81	6	(*Ho* II .43 [200]) *Fe* I .82 (8) II
4046	.....	.....	.58	4	.....	.....	.....
4047	.....	.....	.....	.....	.06	1	*Fe* I .32 (1)
4047	.....	.....	.....	.....	.98	1	.....
4048	.....	.....	.51	5n	.....	.....	*Zr* II .67 (25) *Mn* I .76 15 I
4049	.27	2	.....	.....	.05	2–3n	*Fe* I .34 (1)
4049	.....	.....	.65	2	.91	1	*Gd* II .44 150 *Gd* II .90 200
4050	.80	1:	.55	3	.....	.....	*Zr* II .33 (15) *Dy* II .58 150
4051	.....	.....	.....	.....	.16	1:	*V* I .04 (pred)
4051	.96	1	.....	.....	.96	2n	*Fe* I .93 (2) *Cr* II 2.00 (1) *Fe* I 2.31 (1)
4053	.....	.....	.33	2	.50	1–2	*Fe* I .27 (1) *Gd* II .31 100 *Cr* II .45 (pred)

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4054	.06	1–2	3.85	3	.03	2	*Fe* I 3.83 *Ti* II 3.81 (3) *Cr* II .09 (pred) *Fe* I .19 (⊙ 2)
4055	....	....	.19	3	.02	2	*Fe* I 4.83 (1) *Fe* I 4.88 (1) V *Fe* I .05 (1) V *Mn* I .55 20 I
4056	.12	1	....	....	.18	2	*Ti* II .20 [1] *Fe* I .34 ⊙ I
4057	.37	1	.32	3	.34	1	*Fe* I .36 (1) V *Mg* I .51 (5r)
4058	....	....	.33	1	.67	1:	*Fe* I .77 (1) IV
4059	....	....	.68	2n	....	....	....
4060	....	....	....	....	.52	1	....
4061	.54	1	.58	3	.80	1	*Fe* I .96 (1)
4062	....	....	.47	2	.67	1	*Fe* I .45 (4) III
4063	.80	1–2	.43	4	.56	3	*Fe* I .30 (2) *Gd* II .45 150 *Fe* I .60 (8) II *Cr* II 4.05 (pred)
4065	....	....	.01	2	4.74	1	*Fe* I 4.46 (⊙ 3) *Fe* II 4.77 (*) *V* II .09 (6r) *Ti* I .09 15 III
4066	.54	1	.58	1n	.98	2	*Fe* I .98 (4) III *Ni* II 7.04 (3)
4068	.50	1:	.45	2n	.01	1–2	*Fe* I 7.99 (5) III
4069	....	....	....	....	.04	1	....
4069	....	....	....	....	.97	1	*Fe* I 0.05 (1)
4070	.96	1	.18	5nn	.97	1–2	*Fe* I .78 (2) III *Cr* II .99 (2)
4071	....	....	....	....	.77	1	*Fe* I .75 (7) II
4072	.46	1	....	....	.62	1–2	*Fe* I .52 (1) *Cr* II .63 (pred)
4073	....	....	.32	4–5n	.77	1	*Dy* II .11 200 *Fe* I .77 4n IV *Gd* II .78 200

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
4074	....	....	....	....	.84	1	*Fe* I .79 (3) IV
4075	.50	1	.48	4n	.89	1–2	*Si* II .45 (2) *Cr* II .66 (pred) *Fe* I .94 (1)
4076	....	....	.66	2	.82	1–2	*Fe* I .64 (5) IV *Si* II .78 (1) *Fe* I .81 (1) *Cr* II .87 (pred)
4077	.36	2–3n	.72	5	.68	2–3	*Cr* II .58 (pred) *Sr* II .71 400r *Dy* II .97 600
4078	....	....	....	....	.48	1	*Fe* I .36 (3) IV
4079	....	....	....	....	.36	1	*Fe* I .25 (2) IV *Mn* I .25 12 I *Mn* I .43 10 I
4080	.06	1:	.11	1n	.48	1	*Fe* I .23 (2) IV *Fe* I .88 (1)
4081	.71	1	.38	1	.35	1	*Fe* I .26 (☉ 1)
4082	....	....	.23	1	.34	1–2	*Fe* I .12 (1) *Fe* I .44[☉ 5]
4083	.62	1	.36	1	.60	1–2	*Fe* I .55 (1) *Mn* I .64 12 I *Fe* I .78 (1)
4084	....	....	.50	1	.70	1	*Fe* I .51 (4) IV *Fe* I 5.01 (2) IV
4085	.57	1	.65	3	.53	2	*Fe* I .31 (3) IV *Gd* II .60 200
4086	....	....	....	....	.42	1	*Cr* II .19 (1) *Co* I .31 15 II
4087	.44	1	.27	3	.46	2	*Fe* I .10 (1) *Fe* II .27 (*) *Cr* II .64 (pred)
4089	.04	1	8.67	1	.06	2–3	*Fe* I 8.57 (1) *Fe* II 8.73 (*) *Cr* II 8.85 (pred) *Fe* I .22 (1)
4090	....	....	....	....	.29	1	*Fe* I .09 (1) *Fe* I .33 *Zr* II .52 (10)
4091	....	....	.46	1	....	....	....

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4092	...	...	...	...	.52	1	*Fe* I .29 (1) *Co* I .40 25 I *Fe* I .52 (1) *V* I .69 50 I
4094	...	...	.46	1n	.44	1	...
4095	.30	1:	...	...	...	...	...
4096	...	...	...	...	.22	1	*Fe* I 5.98 (3) IV *Fe* I .12 (1) *Fe* I .22 (3)
4098	.53	2:	...	...	.49	3n	*Cr* I .18 (20n) III *Fe* I .19 (3) II *Cr* II .48 (1) *Ca* I .55 15 III
4100	...	...	...	...	.15	1	*Fe* I 9.98 *Fe* I .17 (⊙ 2) *Fe* I .35 *Fe* I .75 (2) IIA
4101	.75	50	.66	50	.74	15	*Hδ* .74 (7)
4103	.26	1	...	...	...	...	*Si* I 2.95 (5)
4104	.81	2	...	...	.75	1	*Mn* II 5.01 (2) *V* I 5.17 60 I
4106	.73	1:	...	...	.21	1	*Fe* I .27 (1) *Fe* I .44 (1)
4107	...	...	...	...	.55	1	*Fe* I .50 (5) III
4108	...	...	...	...	.57	1	...
4109	...	...	...	...	.79	1	*V* I .78 50 I *Fe* I .81 (4) IV
4110	...	...	.38	2	...	...	...
4110	.95	2	1.56	2	.99	2	*Cr* I .87 20n III *Cr* II 1.04 (2) *Dy* II 1.35 150 *V* I 1.79 100R I
4112	...	...	...	...	.15	1:	*Fe* I .35 (1)
4113	.04	1	.15	1n	.01	1	*Ti* I 2.72 20 II *Fe* I 2.98 (2) V *Cr* II .29 (1)
4114	...	...	.84	2n	.32	1:	*Fe* I .45 (4) IV
4115	.18	1:	...	...	.44	1	*V* I .18 60 I

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4116.......	.68	1	....	....	.94	2nn	*V* I .48 50 I
4117.......	....	....	.14	4	....		*Fe* I .87 (1)
4119.......	.01	1n	8.99	4nn	....		*Fe* I 8.56 (6) IV *Fe* I 8.90 (1)
4119.......	....	....	....	....	.70		
4121.......	....	....	.10	1n	0.91	1	*Co* I .33 60 II *He* I .81 (3) *He* I .98 (1)
4122.......	.24	1–2	....	....	1.92	1:	*Fe* I 1.81 (2) IV
4122.......	....	....	.88	3n	.77	2	*Fe* I .52 (2) IV *Fe* II .67 (*)
4123.......	....	....	....	....	.64	1	*V* I .56 60 I *Fe* I .74 (1) *Fe* I .76 (1)
4124.......	.56	1	.69	2	.86	1–2	*Y* II .91 (15)
4125.......	....	....	....	....	.78	1	*Fe* I .63 (1) *Fe* I .89 (1) *Fe* I 6.19 (2) IV
4127.......	....	....	....	....	.04	1	*Fe* I 6.86
4127.......	.97	5	8.08	7	.91	2	*Fe* I .61 (4) V *Fe* I .81 (2) V *Si* II 8.05 (8) *V* I 8.08 60 I
4129.......	....	....	.66	4	.64	3	*Cr* I .37 20n III *Dy* II .43 100 *Eu* II .73 500R
4130.......	.80	5	.89	7	1.07	1	*Si* II .88 (10)
4132.......	.47	1–2	.45	5	.37	5	*V* I .02 60 I *Fe* I .06 (7) II *Mn* II .28 (1) *Gd* II .28 200 *Cr* II .45 (1) *Fe* I .91 (3) III
4133.......	....	....	.76	2	.90	1–2	*Fe* I .61 *Fe* I .87 (2) *Fe* I 4.34 (1)
4134.......	....	....	....	....	.78	1	*V* I .50 60 I *Fe* I .68 (5)
4135.......	.61	1	.18	2	.68	1	....
4136.......	.94	1	.91	2n	7.17	2n	*Fe* I .53 (1) *Mn* II .91 (2)

TABLE V—*Continued*

λ	θ Aur		α² C Vn		β Cr B		Identification
4138	.58	1	.57	2n	.37	1	*Fe* I 7.98 *Fe* II .37 (*) *Fe* I .86
4139	...	...	...	...	.69	1:	*Fe* I .93 (1) IIA
4140	.19	1	.93	2n	.56	1	*Mn* II .16 (1) *Fe* I .40 (1)
4141	.91	1:	...	...	...	...	*Fe* I .86 (1)
4142	...	...	...	...	.29	2n	...
4143	.41	1	.08	3n	.71	3	*Dy* II .10 300 *Fe* I .42 (5) III *Fe* I .51 *He* I .77 (2) *Fe* I .87 (7) I
4145	...	...	.08	3	4.99	1	[*Fe* I 4.63 (1)]
4145	.83	2	6.10	1	6.14	3	*Cr* II .81 (3) *Fe* I 6.07 (2)
4147	...	...	.04	2	.46	2	*Fe* I .67 (4) III
4149	.48	1	...	...	.34	1–2	*Zr* II .21 (75) *Fe* I .37 (2) V
4149	...	...	...	...	.98	1	*Fe* I .77 (⊙ 2) *Fe* I 0.28 (2)
4150	.49	1	...	...	.90	1:	*Zr* II .98 (10)
4152	...	...	.32	1–2	.05	3	*La* II 1.95 (250) *Fe* I 1.96 (1) *Fe* I .18 (2) IIA
4153	.88	1	.74	1–2	.75	2	*Cr* I .82 20 III *Fe* I .92 (4) IV
4154	...	...	.81	1:	.70	2	*Cr* II .29 (pred) *Fe* I .50 (4) III *Fe* I .82 (4) IV
4155	...	...	...	...	.57	1:	...
4156	.32	1	.09	2n	.60	3	*Zr* II .24 (15) *Fe* I .46 (1) *Fe* I .67 (1) *Fe* I .81 (4) III
4157	.58	1:	8.13	1n	.74	1	*Fe* I .81 (3) IV
4158	...	...	...	...	.97	3	*Fe* I .80 (2) V
4160	...	...	.60	3	.36	1	*Fe* I .56 (1)

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4161	.34	1–2	.50	3	.52	3–4	*Fe* I .08 (1) *Zr* II .21 (20) *Fe* I .49 (1) *Ti* II .52 (1) *Sr* II .81 30
4163	.....	.....	.....	.....	.17	1	.....
4163	.92	1	.64	1–2	.71	2	*Cr* I .63 20 III *Ti* II .65 (40) *Fe* I .68 (1)
4165	.78	1:	.....	.....	.59	2–3	*Fe* I .42 (1)
4167	.23	1	6.90	3n	.40	2n	*Mg* I .27 10n III? *Fe* I .86 (2) *Fe* I .96 (1)
4168	.....	.....	.....	.....	.86	1:	*Fe* I .63 (1) *Fe* I .95 (1)
4169	.....	.....	.50	2	.90	2–3	*Fe* I .78 (1)
4170	.61	1	.72	3	.96	3	*Cr* II .65 (pred) *Fe* I .91 (2) IV
4171	.....	.....	.86	3	.90	3	*Fe* I .70 (2) *Fe* I .90 (2) *Ti* II .91 (30) *Cr* II .92 (pred)
4172	.11	1	.....	.....	.76	2	*Fe* I .64 (1) *Fe* I .75 (2) IIA
4173	.64	1	.63	3–4n	.51	2–3	*Fe* I .32 (2) IV *Fe* II .48 (6) *Ti* II .54 (1)
4174	.....	.....	.....	.....	.35	1	.....
4175	.80	1	.47	2–3n	.69	1	*Fe* I .64 (4) III
4176	.....	.....	.71	1	.69	2	*Fe* I .57 (2) IV
4177	.59	1	.68	4	.78	3	*Y* II .54 (125) *Fe* I .60 (2) IIA
4178	.93	2	9.20	3n	9.22	4	*Fe* II .87 (6) *Cr* II 9.41 (2)
4180	.....	.....	.87	1–2	.85	1	.....
4182	.08	1	.19	2	1.94	3–4	*Fe* I 1.76 (6) III *Fe* I .39 (2) IV
4183	.....	.....	.25	1	.....	.....	*V* II .43 (35)

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
4184	.40	1	.37	3	.05	3–4	⊙ II .00 (4) *Gd* II .25 300 *Ti* II .33 (0)
4185	....	....	....	....	.28	1	*Fe* I 4.90 (4) III
4187	.35	2n	.15	2–3n	.00	3	*Fe* I .05 (6) III
4187	....	....	....	....	.67	3	*Fe* I .59 (⊙ 2) *Fe* I .81 (6) III
4188	....	....	.80	1–2	.82	2	⊙ (II)? .74 (4)
4190	.60	1–2n	9.71	1	.19	1	*Ti* II .29 [1] *Si* II .74 (3)
4191	....	....	.24	3n	.41	4	*Gd* II .06 200 *Fe* I .45 (6) III *Fe* I .68 (2)
4193	....	....	.72	2n	.43	2	....
4195	.42	2	.51	2n	.28	3	*Fe* I .34 (3) IV *Fe* I .62 (2)
4196	....	....	....	....	.23	1	*Fe* I .22 (2) IV
4198	.27	1–2	.16	3n	.31	4–5n	*Si* II .17 (2) *Fe* I .27 (1) *Fe* I .31 (6) III *Fe* I .65 (2) V
4199	....	....	....	....	.21	1	*Fe* I .10 (6) III *Y* II .28 (5)
4200	....	....	....	....	.03	1	*Fe* I 9.99 1 IIA
4200	.68	2	.61	2–3	.96	1	*Mn* II .25 (2) *Fe* I .92 (1) V
4202	....	....	....	....	.01	1	*Fe* I .03 (7) *V* II .35 (35)
4202	.56	1	.61	1–2	.65	1	*Fe* I .76 (1)
4203	....	....	.68	1:	.85	1	*Fe* I .57 (1) *Fe* I .95 (1) *V* II 4.20 (8)
4204	.97	1	.98	9	5.06	5	*Y* II .69 (10) *Gd* II .84 100 *Eu* II 5.05 500 *V* II 5.09 (30)
4206	.79	1	7.78	3–4	7.10	2	*Mn* II .43 (2) *Fe* I .70 (2) IA *Fe* I 7.13 (2) IV *Cr* II 7.34 (pred)

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
4208	....	....	....	....	.54	2	*Fe* I .61 (2) V *Zr* II .98 (30)
4209	.74	1n	....	....	.57	1–2	*V* II .80 (12)
4210	....	....	....	....	.19	1–2	*Fe* I .36 (6) III
4211	....	....	.80	2	.73	1–2	*Zr* II .88 (12) *Gd* II 2.01 200
4213	.06	1	.49	3	.48	1	*Fe* I .42 (2) IV *Fe* I .65 (2) IV
4215	.28	2	.34	4	.53	6	*Gd* II 4.97 150 *Fe* I .42 (2) IV *Sr* II .52 300r *Cr* II .78 (pred)
4217	.25	1	.31	2n	.42	3	*Cr* II .09 (pred) *Gd* II .15 100 *Fe* I .56 (2) IV *Cr* I .63 15 III
4219	.45	1	.45	1	.24	2–3n	*Fe* I .36 (5) IV
4220	....	....	.90	1:	.53	2–3n	*Fe* I .35 (2) IV
4221	.55	1	....	....	.55	1	....
4222	....	....	.86	2n	.27	2	*Fe* I .23 (5) III
4224	.48	1	.74	2n	.23	3	*Fe* I .17 (3) IV *Cr* II .85 (2)
4225	....	....	....	....	.51	2	*V* II .21 (20) *Fe* I .46 (4) IV
4227	.12	1	.19	3	.64	2	*Fe* I 6.43 (2) IV *Ca* I 6.73 500 I
4227	....	....	....	....	.30	3	*Fe* I .45 (7) III
4229	.67	1	.57	2–3	.64	3	*Fe* I .52 (1) *Fe* I .75 (1) III *Cr* II .82 (pred)
4232	....	....	....	....	.16	1	....
4233	.16	4	.15	4	.29	4	*Fe* II .16 (8) *Cr* II .25 (1) *Fe* I .61 (6) III
4235	....	....	.47	2–3	....	....	....
4235	.81	2	6.45	1	6.04	3	*Y* II .73 (20) *Fe* I .95 (8) III
4237	....	....	....	....	.96	1	*Fe* I 8.04 (1) IV

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
4238	.73	2	.36	3n	.86	2	*La* II .38 400 *Fe* I .83 (4) IV
4239	....	....	....	....	.88	2	*Mn* I .73 5 II *Fe* I .85 (2) III
4240	.57	1:	.33	1n	....	....	....
4242	.27	1	.13	2	.48	3–4	*Cr* II .35 (5) *Mn* II .37 (2) *Fe* I .59 (1) *Fe* I .73 (2)
4243	....	....	.48	v	.63	1	⊙ (I)? .45 (3) *Fe* I .79 (1)
4244	.17	1	....	....	....	....	*Mn* II .24 (1)
4245	.83	1	.30	2nn	.49	....	*Fe* I .26 (2) III *Fe* I .88 (1)
4246	....	....	.29	r	.34	3nn	*Fe* I .09 (2) V *Sc* II .83 (100)
4247	.43	1	....	....	.26	....	*Fe* I .44 (5) III
4249	....	....	.02	2nn	8.31	1	*Fe* I 8.22 (2) IV *Fe* I 8.42
4250	.18	1	.33	1–2	.10	3	*Fe* I .13 (7) III
4250	....	....	....	....	.82	3–4	*Fe* I .79 (8) II
4251	....	....	.82	2–3	.78	1	*Gd* II .76 300
4252	.88	2	3.07	2n	.54	1	*Cr* II .66 (1) *Mn* II 3.02 (2)
4253	....	....	....	....	.52	1:	*Gd* II .36 150 *Gd* II .62 150
4254	.38	1	.61	1–2	.48	3–4	*Cr* I .34 500 II
4255	.74	1	6.02	4	6.08	2	*Fe* I .85 (1) *Fe* I 6.21 (2)
4258	.44	1–2n	7.97	2–3	.44	3–4	*Zr* II .05 (12) *Fe* II .14 (*) *Fe* I .39 (1) IA *Fe* I .61 (1) *Fe* I .95 (1)
4259	....	....	.29	2	....	....	*Mn* II .26 (2)
4260	....	....	.57	1	.36	4	*Fe* I 9.99 (2) *Fe* I .14 (2) *Fe* I .49 (10) III

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4261.......	.90	2	.69	2–3	.94	3	*Cr* II .81 (pred) *Cr* II .91 (2) *Gd* II 2.09 250
4263.......	.67	1	....	....	.13	2–3n	....
4264.......	....	....	.30	2n	.35		*Cr* II .18 (pred) *Fe* I .21 (2)
4265.......	....	....	....	....	.46	1	*Fe* I .26 (2)
4266.......	.11	1	....	....	....	....	....
4267.......	....	....:....	.07	3	.29	1–2n	*Fe* I 6.97 (2) IV *C* II .02 (8) *C* II .27 (10) *Fe* I .83 (2) IV
4269.......	.14	2	.10	2	.09	3–4	*Fe* I 8.75 (2) IV *Cr* II .30 (1)
4270.......	....	....	.55	5	....	....	....
4271.......	.39	1	....	....	.15	2	*Fe* I .17 (7) III
4271.......	....	....	.97	2	.79	2–3	*Fe* I .76 (8) II
4273.......	.46	1:	.40	3	.35	2–3	*Fe* II .31 (1)
4274.......	....	....	....	....	.81	2–3	*Cr* I .80 400 II
4275.......	.23	2n	.28	2–3n	.56	2	*Cr* II .56 (1)
4278.......	.23	1	.02	2–3n	.06	3	*Fe* II .13 (1) *Fe* I .23 (1)
4280.......	.58	1	.25	3–4	.57	3	*Cr* II .34 (pred) *Gd* II .50 200
4282.......	.29	1	.08	1	.57	2	*Zr* II .20 (6) *Fe* I .41 (6) III *Mn* II .50 (3)
4284.......	.40	2	.14	2–3	.19	2	*Cr* II .24 (2)
4285.......	....	....	....	....	.36	1	*Fe* I .45 (2) IV
4286.......	....	....	.36	2–3	.47	1	*Ti* I .01 25 II *Fe* I .44 (1) *Zr* II .51 (5) *Fe* I .68 (1) *Fe* I .89 (1) *Fe* I .98 (1)
4287.......	.86	1:	.97	4	8.03	1–2	*Ti* II .89 (2)

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4290	.00	1–2	.08	5n	9.96	7	*Cr* I 9.73 (350) II *Ti* II .22 (50)
4292	.25	1	1.89	2	.17	1–2n	*Fe* I .13 (pred) *Mn* II .28 (2) *Fe* I .29 (1)
4292	....	....	.81	3	....	....	....
4294	.44	1:	.02	1n	.10	2	*Ti* II .10 (40) *Fe* I .13 (6) II
4295	....	....	.01	1–2	....	....	....
4296	.38	1	.60	5n	.40	4n	*Gd* II .04 150 *Fe* II .56 (6)
4298	....	....	....	....	.06	1	*Fe* I .04 (2) IV
4299	....	....	....	....	.35	3	*Fe* I .25 (7) III
4300	.01	1	.20	4	.02	3	*Ti* II .05 (60) *Mn* II .21 (1)
4301	....	....	.78	3–4	2.14	3	*Ti* II .93 (15) *Fe* I 2.19 (2) *Ca* I 2.53 60r I
4303	.37	2	.30	4	.04	3	*Fe* II .18 (4)
4304	....	....	....	....	.71	1	*Fe* I .55 (1)
4305	.38	1:	.27	1–2	.49	3	*Fe* I .46 (2) IV *Sr* II .46 40 *Ti* I .91 60 II
4306	....	....	....	....	.65	1	....
4308	.33	1	....	....	7.94	3	*Ca* I 7.74 45 I *Ti* II 7.86 (40) *Fe* I 7.91 (8R) II
4309	....	....	.02	2n	.41	2–3	*Dy* II 8.62 100 *Fe* I .04 (2) *Fe* I .38 (2) IV *Y* II .62 (50)
4309	....	....	.97	1:	....	....	....
4311	....	....	.15	1:	0.75	1	*Fe* I 0.78 (1)
4312	.67	1	.90	2–3	.81	3	*Ti* II .87 (35)
4314	.71	1	....	....	.25	3	....
4314	....	....	.95	2–3	5.91	3	*Ti* II .98 (40) *Fe* I 5.09 (5) III *Sc* II 5.09 (30)

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
4316	....	....	....	....	.04	1	....
4317	....	....	.31	1–2	6.95	1	*Ti* II 6.81 (1) *Zr* II .32 (12)
4318	....	....	....	....	.52	1	*Ca* I .65 45 II
4319	.66	1n	.29	1	.49	1	*Fe* I .46 (pred)
4320	....	....	.82	2–3	.98	4	*Sc* II .73 (20) *Ti* II .97 (1)
4323	.30	1:	.06	1n:	2.83	1:	*La* II 2.51 (100)
4325	....	....	....	....	.12	1n	*Sc* II .00 (20)
4326	.14	2–3n	5.65	3–4	5.74	2–3	*Fe* I 5.77 (9) II *Mn* II .71 (3)
4326	....	....	....	....	.94	2	*Fe* I .76 (2) *Fe* I 7.10 (2) V
4328	....	....	....	....	.09	1	....
4329	....	....	.25	1:	.26	1:	....
4330	.30	1	.35	4	.47	4	*Ti* II .26 (0) *Gd* II .58 100 *Ti* II .71 (0)
4333	.29	1	....	....	....	....	*Zr* II .27 (15)
4334	....	....	....	....	.70	1–2	....
4337	.32	1:	....	....	.70	3	*Fe* I .05 (5) II *Ti* II .32 [1] *Cr* I .57 30 I *Ti* II .92 (50)
4340	.48	50	.54	40	.44	20	*H*γ .47 (8)
4342	.39	1:	....	....	.37	1	....
4344	.40	1	3.85	4	.29	3	*Mn* II .03 (1) *Ti* II .29 (2) *Cr* I .51 40 I
4345	.71	1	....	....	6.01	1	....
4348	.42	1	7.48	2:	7.96	1–2	*Mn* II .48 (1)
4350	.09	1:	....	....	.71	1:	*Ti* II .86 (1) *Cr* I 1.06 (20) I
4351	.67	1–2n	.68	3–4	.84	2	*Fe* II .77 (6) *Cr* I .77 (60) I *Mg* I .94 30 IV

TABLE V—*Continued*

λ	θ Aur		α² C Vn		β Cr B		Identification
4352.......	....	....	....	....	.70	1	*Fe* I .74 (4) IIIB *V* I .89 50 I
4354.......	.43	1	....	....	.41	1n	....
4355.......	....	....	.11	5	.12	2	*Ca* I .10 25 III
4356.......	....	....	....	....	.85	1–2	....
4357.......	.27	1	.24	1–2	.52	1	....
4358.......	....	....	....	....	.59	1	*Fe* I .61 (2) IV *Y* II .73 (30)
4359.......	.53	1	.76	1–2	.78	1–2	*Zr* II .74 (10)
4361.......	.28	1	.47	3–4	.34	1–2	....
4363.......	.00	2	.70	4–5	.15	2	....
4364.......	....	....	....	....	.62	1:	....
4365.......	.32	1	.71	1n	.86	1	*Mn* II .29 (1) *Fe* I .90 (1)
4368.......	.20	1	7.68	5	7.65	4n	*Fe* I 7.58 (2) IV *Ti* II 7.67 (15) *O* I .30 (10)
4369.......	.40	1	.53	3–4	.60	4	*Fe* II .40 (*) *Fe* I .78 (3) III
4371.......	....	....	.95	2n	.09	1	*Zr* II 0.95 (8) *Cr* I .28 (20) I
4373.......	....	....	....	....	.40	r	*Cr* I .27 (8) I *Fe* I .57 (2)
4374.......	.67	1:	.91	3–4	.51	3nn	*Sc* II .46 (30) *Fe* I .50 (1) *Ti* II .83 (1)
4375.......	....	....	....	....	.70	v	*Fe* I .93 (5) I, II
4376.......	.92	2n	7.18	1n	7.13	1	*Fe* I .78 (1)
4379.......	.93	1	0.20	1–2n	0.48	2–3n	*Mn* II .74 (1) *Zr* II .77 (9) *Mg* I 0.39 (5)
4382.......	.37	1	....	....	....	....	....
4384.......	.01	2n	3.97	3–4n	3.44	3	*Fe* I 3.55 (10) II
4385.......	....	....	.35	2	4.90	2–3	*Mg* II 4.64 (8) *V* I 4.73 125 II *Cr* I 4.98 20 I *Fe* II .39 (5)

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4386.......	....	....	.65	4–5	.76	2	*Ti* II .86 (10)
4387.......	.43	1	....	....	.84	2	*Fe* I .90 (2) IV
4388.......	....	....	.43	3	....	....	....
4389.......	.98	1:	....	....	....	....	*V* I .99 100 II *Mg* II 0.59 (10)
4391.......	.82	1	.10	5n	.13	3–4n	*Fe* I 0.96 (3) IV *Ti* II 0.98 (tr) *Fe* I .46 (1)
4393.......	....	....	.51	2	.72	1	*Ti* II 4.06 (2)
4395.......	.49	1n	.27	4n	.15	3n	*Ti* II .04 (60) *V* I .24 80 II *Fe* I .29 (2) *Fe* I .51 (1)
4398.......	....	....	.07	2–3n	7.73	1–2n	*Y* II .02 (50) *Ti* II .32 [1]
4400.......	.30	1:	9.69	2	9.61 }	3nn	*Ti* II 9.77 (35) *Fe* I .35 (1) *Sc* II .38 (20) *V* I .59 60 II *Ti* II .63 (pred)
4401.......	....	....	.36	1	.37 }		*Fe* I .30 (3) *Fe* I .45 (2) *Ni* I .55 30 III
4403.......	....	....	.01	2–3	.07	3	....
4404.......	....	....	.70	5	.80	3	*Fe* I .75 (8) II
4406.......	....	....	.78	1	.73 }	2nn	*V* I .65 80 I
4407.......	....	....	....	....	.... }		*V* I .65 70 I *Ti* II .67 (1) *Fe* I .72 (2) III *V* I 8.21 70 I
4409.......	.99	1:	.67	5	.26 }		*Fe* I 8.42 (4) III *Fe* I .12 (2) *Ti* II .25 (tr) *Ti* II .54 (tr)
4410.......	....	....	....	....	.68	1	*Fe* I .72 (2) *Ti* II 1.08 (15)
4411.......	....	....	.65	1n	2.09	1	*Ti* II .95 (1)
4413.......	.36	1:	4.17	3–4n	.51	2	....
4414.......	.51	1	....	....	5.05	2–3	*Fe* I 5.13 (8) II

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
4416	.99	2	.62	1n:	.74	1–2	*Fe* II .81 (4)
4417	...	...	.66	1:	.74	1–2	*Ti* II .72 (40)
4419	.54	1n	.10	2–3	8.99	1–2	*Gd* II .03 150 *Ti* II .34 (1) *Mn* II .78 (2)
4420	...	...	.90	1–2:	.87	1:n	...
4422	.24	1n	.13	4n	.51	3–4n	*Ti* II 1.95 (1) *Fe* I .57 (4) III *Y* II .59 (40)
4424	.80	1	.67	4n	.00	2	*Fe* I 3.86 (2)
4425	...	...	...	...	.47	1	*Ca* I .43 50 I *Fe* I .66 (1)
4427	.96	1	.38	2–3	.38	3nr	*Fe* I .31 (5) I *Ti* II .89 (pred) *Mg* II 8.00 (7)
4430	.67	1–2	.42	3–4n	.12	3–4	*Fe* I .20 (2) IV *Fe* I .62 (4) III
4432	.43	1:	...	...	1.82	1	*Ti* II .08 (tr)
4433	...	...	...	...	.26	2n	*Fe* I .22 (2) IV *Fe* I .39
4434	.00	1	.01	3–4	...	...	*Mg* II 3.99 (8)
4436	.15	1	5.52	4–5	5.42	4–5	*Ca* I 4.95 60 I *Fe* I 5.15 (2) IIA *Ca* I 5.67 40 I *Mg* II .48 (5)
4438	...	...	.08	1:	.01	2	...
4441	...	...	...	...	.33	2n	*Fe* I 0.84 (1) *Fe* I 0.97 (2) *Ti* II .73 (pred)
4442	.42	1:	...	...	...	...	*Zr* II .99 (25)
4443	...	...	.39	6	.85	3n	*Fe* I .20 (3) III *Ti* I .80 (50)
4444	.79	1:	.51	3	...	...	*Ti* II .56 (1)
4445	...	...	.91	2	6.01	2n	*Fe* I 6.85 (2) *Fe* I 7.14 (2) IV
4447	.70	1:	.68	4–5	.67		*Fe* I .73 (5) III
4449	.78	1:	...	...	.53	1	...

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4450	....	....	.75	3n	.39	3	*Fe* I .32 (2) *Ti* II .49 (10)
4451	.58	1:	....	....	....	....	....
4453	....	....	....	....	.02	1	....
4454	....	....	.91	2–3n	.96	3n	*Fe* I .39 (3) III *Fe* I .67 (1) *Ca* I .77 80 I *Zr* II .80 (10) *Fe* I 5.04 (2)
4455	.50	1	....	....	....	....	*Ca* I .87 40 I *Ca* I 6.61 10 II
4457	.22	1:	.24	1–2:	....	....	*Ti* II 6.64 (tr) *Zr* II .42 (8)
4458	....	....	....	....	.15	1	*Fe* I .10 (2) *Mn* I .26 12 II
4459	....	....	....	....	.16	2	*Ni* I .05 20 III *Fe* I .13 (5) III
4461	.34	2	.42	3	.57	3–4	*Fe* I .21 (2) *Zr* II .23 (10) *Fe* I .66 (4) I *Fe* I 2.01 (3) IV
4463	....	....	....	....	.35	1	....
4464	.60	1	.43	1:	.59	3	*Ti* II .46 (1) *Mn* I .68 8 II *Fe* I .77 (2) IV
4466	.04	1	....	....	.57	2	*Fe* I .56 (5) II *Fe* I .94 (2)
4467	.40	1	....	....	....	....	....
4468	....	....	.34	2–3n	.55	1–2	*Ti* II .49 (50)
4469	....	....	....	....	.16	1–2	*Ti* II .15 (tr) *Fe* I .39 (4) IV
4470	.89	1:	.94	3	1.10	2	*Ti* II .86 (tr)
4472	.95	1n	3.17	3	.69	2	*Fe* I .71 (2) *Fe* II .91 (pred)
4474	....	....	....	....	.46	1n	....
4476	.10	1:	5.25	1	5.94	2	*Fe* I .02 (7) III
4477	....	....	.22	1n:	....	....	....
4478	.53	1	.70	1:	.19	1–2	*Mn* II .74 (1)

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4481	.22	5	.25	8	.24	4–5	*Mg* II $\left\{ \begin{matrix} .13 \\ .33 \end{matrix} \right\}$ (100)
4482	....	....	....	....	.60	1	*Fe* I .18 (3) I *Fe* I .26 (4) *Fe* I .75 (2)
4483	.97	1	.60	2–3	....	....	....
4484	....	....	....	....	.81	1n	*Fe* I .24 (3) IV
4485	....	....	.98	1–2	....	....	*Fe* I .67 (2)
4486	.66	1	....	....	....	....	....
4488	....	....	....	....	.16	1	*Fe* I .13 (2) *Ti* II .32 (15)
4489	.18	2	8.98	3–4n	.11	2	*Fe* I 8.92 (2) IV *Fe* II .21 (4)
4491	.44	1	.53	2	.54	1	*Fe* II .41 (4)
4493	.79	1	....	....	.22	1:	*Ti* II .54 [1]
4494	....	....	.11	3n	.52	1–2	*Zr* II .41 (8) *Fe* I .57 (5) III
4497	.14	1	.14	1:	6.41	1	*Cr* I 6.86 25R I *Zr* II 6.96 (15)
4499	.44	1	....	....	8.98	1	*Cr* II 8.73 (6 III)
4500	.99	1–2	.80	3–4n	....	....	....
4501	....	....	....	....	.25	3n	*Ti* II .27 (40)
4503	.39	1	.16	3–4n	....	....	....
4505	.10	1	....	....	4.65	1	*Cr* II 4.54 (pred) *Fe* I 4.85 (2)
4507	....	....	.06	2	6.68	2n	*Ti* II 6.74 (pred)
4507	.96	2n	8.16	2–3	8.82	1–2n	*Fe* II 8.29 (8)
4509	....	....	.87	3	....	....	....
4512	.04	1n	1.99	3	1.93	2	....
4514	.19	1	.38	4–5	.66	3	*Fe* I .19 (2)
4515	.30	3–4	.55	4	.43	3	*Fe* II .34 (6)
4517	.82	1:	....	....	.29	1	*Fe* I .53 (2)

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
4518	....	....	.75	1	.52	1	*Ti* I .03 50 II
4519	.82	1	0.23	4	0.20	2–3	*Fe* II .24 (6)
4522	.61	1	.68	5–6	.79	4	*Fe* II .64 (6) *Ti* I .80 40 II
4524	....	....	.87	1	5.01	3	*Fe* I 5.15 (3) IV *Ti* II 5.25 (pred)
4526	.18	1	....	....	.92	1–2n	*Cr* I .46 (15) II *Fe* I .57 (2)
4528	....	....	....	....	.71	1–2	*Fe* I .62 (7) II
4529	....	....	.76	1	.55	1	*Fe* I .56 (1) *Fe* I .68 (2)
4531	.90	1:	....	....	.10	2	*Fe* I .16 (5) II
4533	.84	1	.97	6	.30	1	*Ti* I .25 80 II *Ti* II .97 (30)
4534	.92	1	....	....	.13	3	*Fe* II .18 (*) *Mg* II .26 (4)
4536	....	....	.44	1:	5.62	2	*Ti* I 5.57 50 II *Ti* I 5.92 40 II *Ti* I .05 40 II
4537	.48	1:	8.04	1	....	....	....
4539	.56	1–2	.74	2–3	.71	2–3	....
4541	.51	1	.62	4	.08	2	*Fe* II .33 (1) *Fe* II .53 (*)
4544	....	....	.87	1n	.11 }	2n	*Ti* II .03 (tr) *Cr* II .69 (pred) *Ti* I .70 30 II
4545	.36	1:	....	....	.90 }		*Ti* II .16 (tr)
4546	....	....	.95	1–2n	....	....	....
4549	.45	3–4	.58	7–8	.61	6	*Fe* II .48 (4) *Ti* II .62 (60)
4552	.11	1	.02	1:n	.50	1	*Ti* II .25 (pred) *Ti* I .46 35 II *Fe* I .55 (2)
4555	.38	2–3n	....	....	3.91 }	3n	*Zr* II .96 (12) *Ba* II 4.04 1000R *Cr* II 5.00 (2)
4555	....	....	.89	4n	6.21 }		*Fe* II .90 (6)

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4558	.81	4–5	.57	4	.65	4	*Cr* II .66 (20) *Cr* II .78 (pred)
4561	.59	1	......	......	0.84	1n	*Fe* I 0.11 (2)
4564	.28	1	3.66	2–3	3.77	2–3	*Ti* II 3.76 (30)
4566	.02	1	5.71	3	5.62	2	*Fe* I 5.32 (2) *Fe* I 5.68 (2) *Cr* II 5.78 (2)
4568	.49	1:	......	......	......	......	*Ti* II 8.31 [1]
4569	......	......	.44	1	.67	1	......
4572	.16	1:n	.44	5	1.81	4n	*Ti* II 1.97 (50)
4574	......	......	......	......	.85	1	*Fe* I .73 (2)
4576	.34	1	......	......	.34	2	*Fe* II .31 (4) *Fe* II .34 (10)
4579	.89	1	......	......	.67	2n	*Fe* I .34 (1) *Fe* I .83 (1) *Cr* I 0.06 (20) I *Ti* II 0.47 [1]
4581	......	......	......	......	.46	1	*Ca* I .41 40 II *Fe* I .53 (2)
4582	......	......	......	......	.57	1	*Fe* II .83 (*)
4583	.79	3n	......	......	.83	2–3	*Ti* II .45 [1] *Fe* II .84 (8)
4585	......	......	......	......	.90	1–2	*Ca* I .87 50 II *V* I 6.36 50 I
4588	.16	2–3n	......	......	.36	3	*Cr* II .21 (20) *Cr* II .40 (pred)
4590	......	......	......	......	.00	1	*Cr* II 9.89 (pred) *Cr* II 9.94 (1) *Ti* II 9.96 (2)
4592	.10	1	......	......	.25	2–3	*Cr* II .06 (2) *Fe* I .66 (4) IB
4593	.99	1:	......	......	.79	1–2	*V* I 4.10 60 I
4596	.18	1	......	......	5.89	1–2	*Fe* I 5.37 (2) *Fe* II 5.69 (*) *Fe* I .06 (2)
4598	.89	1	......	......	.06	1–2	*Fe* I .14 (2)

TABLE V—*Continued*

λ	θ Aur		a^2 C Vn		β Cr B		Identification
4600	.85	1:	...	...	1.10	2–3n	*Cr* I .75 20 I *Fe* II 1.38 (*) *Fe* I 2.01 (2)
4602	...	...	...	...	.91	1	*Fe* I .95 (4) IB
4604	.94	1	...	...	...	...	...
4605	...	...	...	...	.60	1–2n	*Fe* I .25 (2)
4607	...	...	...	...	.62	2	*Fe* I .66 (4) V
4609	...	...	...	...	.49	1	...
4612	.30	1:	...	...	1.52	2–3	*Fe* I 1.29 (4) III
4613	...	...	...	...	.38	1	*Fe* I .22 (3) V *Cr* I .37 15 I
4614	.36	1:	...	...	...	...	...
4616	.73	2–3	...	...	.37	3	*Cr* I .14 (25) I *Cr* II .67 (3)
4619	.33	2	...	...	.08	3	*Fe* I 8.76 (2) *Cr* II 8.82 (10) *Fe* I .30 (4) IV
4621	.91	2–3n	...	...	.91	1n	...
4625	...	...	...	...	.28	2–3n	*Fe* I .06 (4) IV
4626	.04	1n	...	...	...	...	*Cr* I .19 (20) I
4628	...	...	...	...	.25	1	...
4629	.31	2–3	...	...	.43	1	*Fe* II .33 (4) *Ti* I .34 15 III
4632	...	...	...	...	.39	1	*Fe* I .92 (3) III?
4634	...	...	...	...	.02	2–3n	*Cr* II .09 (10)
4635	.18	2–3n	...	...	...	...	*Fe* II .35 [1]
4638	.54	1	...	...	7.73	2	*Fe* I 7.51 (4) IV *Fe* I .02 (4) IV
4640	...	...	...	...	.26	1n	*Ti* I 9.94 15 III
4641	.25	1–2	...	...	...	...	...
4643	.38	1	...	...	.66	1:	*Fe* I .47 (3)
4646	.26	1	...	...	.57	3	*Cr* I .17 40 I
4648	...	...	...	...	.43	1–2	*Ni* I .66 15 III *Fe* II 9.32 (*)

TABLE V—*Continued*

λ	θ Aur		α^2 C Vn		β Cr B		Identification
4651.......	.39	1:	....	....	.55	2	*Cr* I .30 (20) I
4654.......	.08	1:	....	....	.50	3	*Fe* I .50 (4) II? *Fe* I .64 (3) V
4656.......	....	....			.87	3n	*Fe* II 7.01 (*)
4657.......	.07	1	....	....	....	....	*Ti* II .21 (tr)
4659.......	.41	1	....	....	....	....	....
4663.......	.75	2	....	....	.57	3	*Fe* II .72 (*)
4666.......	.88	2	....	....	.76	4	*Fe* II .75 (*) *Fe* I 7.46 (4) V
4670.......	.02	2	....	....	....	....	*Sc* II .40 (10)
4673.......	.16	2	....	....	....	....	....

TABLE VI

ELEMENTS PRESENT IN A-TYPE STARS

	η Leo	υ Sgr	α Cyg	ϵ Aur	α Lyr	γ Gem
H......	Stronger than in α Cygni; much weaker than in Vega and Sirius	Weaker by far than in other standard stars	Weak and narrow	Weak and narrow	Very wide and strong	Very wide and strong
He I....	All strong lines present but not outstanding	Lines very strong; probably variable in intensity	λ 4471 present and unblended on three-prism plates	Absent	λ 4471 unblended on three-prism plates; slightly < α Cygni	λ 4471 as in Vega
C I.....	Absent	Absent	Absent	Lines in 4770 region present; weaker than in α Persei	Absent	Absent
C II....	Faintly present	Present; of moderate intensity	Doubtfully present	Absent	Absent	Absent
N II....	Faintly present	Present; rather weak	Absent	Absent	Absent	Absent
O I.....	Faintly present	Absent	Doubtfully present	Absent	Doubtfully present	Faintly present
O II....	Doubtful; possibly a trace	Faintly present	Absent	Absent	Absent	Absent
Mg I...	Singlets faintly present; strong triplets not in region observed	Singlets doubtfully present	Rather weak	Strongest singlet lines of intensity 2	Strongest singlet lines of intensity 1	Considerably stronger than in α Lyrae
Mg II...	λ 4481 strong; weak high-excitation lines also present	As in η Leonis	As in η Leonis	λ 4481 strong; fainter lines not observed	See ϵ Aurigae	See η Leonis
Al I....	Ultimate doublet rather faint	Probably somewhat weaker than in η Leonis	See η Leonis	Lines of considerable strength	Of moderate intensity	As in α Lyrae
Al II....	Absent	Absent	Probably faintly present	Absent	Absent	Absent

TABLE VI—*Continued*

	15 U Ma	α And	τ^9 Eri	φ Her	θ Aur	β Cr B
H......	Considerably weaker than in Vega	Wide and strong	Wide and strong	Wide and strong	Wide and strong	Considerably weaker than in Vega
He I....	Absent	Principal lines present but faint	Principal lines present but faint	Principal lines present but faint	Probably absent	Absent
C I.....	Spectral region not included	Spectral region not included	Spectral region not included	Spectral region not included	Spectral region not included	Spectral region not included
C II....	Absent	Present; rather weak	Present; rather weak	Present; rather weak	Absent	Absent
N II....	Absent	Doubtfully present	Absent	Absent?	Absent	Absent
O I*....	Uncertain because of blends	Absent	Uncertain because of blends	Uncertain because of blends	Presence very doubtful	Uncertain because of blends
O II	Absent	Absent	Absent	Absent	Absent	Absent
Mg I...	Probably somewhat stronger than in γ Geminorum	Singlets absent	Singlets rather weak	Singlets rather weak	Singlets faintly present	Somewhat stronger than in θ Aurigae
Mg II...	See ε Aurigae	λ 4481 strong; trace of fainter lines	See α Andromedae	See α Andromedae	See α Andromedae	See ε Aurigae
Al I....	See ε Aurigae	Not in range measured	Not in range measured	Not in range measured	Presence doubtful	Not in range measured
Al II....	Absent	Absent	Absent	Absent	Absent	Absent

* Strong lines of *N* I and *O* I have been observed in the infra-red region of several A-type stars by Merrill (*Ap. J.*, **79**, 183, 1934).

TABLE VI—*Continued*

	η Leo	υ Sgr	α Cyg	ϵ Aur	α Lyr	γ Gem
Si I....	Absent	Absent	Absent	Absent	λ 4103 probably masked in wing of $H\delta$	See α Lyrae
Si II....	$\lambda\lambda$ 4128–4130 outstanding fainter lines also present	See η Leonis; $\lambda\lambda$ 4128–4130 almost as strong as $H\delta$	See η Leonis	$\lambda\lambda$ 4128–4130 strong	See ϵ Aurigae	See ϵ Aurigae
Si III....	λ 4552 may be faintly present	May be present	Absent	Absent	Absent	Absent
S II	Faintly present	Well marked; stronger than in any other star	A trace may be present	Absent	Absent	Absent
A II....	Probably absent	A number of unblended lines; definitely present	Absent	Absent	Absent	Absent
Ca I....	λ 4226 faintly present	Probably absent	λ 4226 faintly present	λ 4226 strong	λ 4226 of moderate intensity	As in α Lyrae
Ca II...	For intensity of K line see Table I	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
Sc II....	Rather weak	Rather weak	Slightly > η Leonis	Very strong	As in α Cygni	About as in α Cygni
Ti I....	Absent	Absent	Absent	Absent? Trace of λ 4533 suspected	Absent?	Probably faintly present
Ti II...	For behavior of λ 4501 see Table I	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
V I.....	Absent	Absent	Absent	Probably absent	Probably a trace	As in α Lyrae
V II....	Faintly present	Absent	Rather weak; stronger than in η Leonis	Well marked	Absent	Present; rather weak

TABLE V—*Continued*

	15 U Ma	α And	τ^9 Eri	φ Her	θ Aur	β Cr B
Si I....	λ 4103 of moderate intensity	Absent?	See α Lyrae	See α Lyrae	Possibly faintly present	See α Lyrae
Si II....	Moderately strong	Moderately strong	All lines strong	All lines present but < τ^9 Eridani	λλ 4128–4130 strong; fainter lines doubtful	Strong lines present but faint
Si III...	Absent	Absent	Probably faintly present	As in τ^9 Eridani	Absent	Absent
S II	Absent	Absent	Faintly present	Probably a trace	Absent	Absent
A II....	Absent	Absent	Absent	Absent	Absent	Absent
Ca I....	See ε Aurigae	Absent	Absent	λ 4226 may contribute to very faint blend	λ 4226 contributes to faint blend	λ 4226 present as weak line
Ca II...	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
Sc II....	Blended; probably of moderate intensity	Probably absent	May be faintly present	As in α Lyrae	Absent?	Blended; probably present
Ti I....	Present but rather weak	Absent	Absent	Absent	Absent	Faintly present
Ti II....	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
V I.....	Faintly present	Absent	Absent	Absent	Absent	Probably contributes to blend
V II....	Of moderate intensity	Absent	Possibly a trace	Absent	Absent	Possibly faintly present

TABLE VI—*Continued*

	η Leo	υ Sgr	α Cyg	ϵ Aur	α Lyr	γ Gem
Cr I....	Strongest line faintly present	See η Leonis	See η Leonis	Moderately strong	λ 4254 probably contributes to blend	As in ϵ Aurigae
Cr II....	For behavior of λ 4558 see Table I	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
Mn I...	Ultimate lines near λ 4030 probably faintly present	Probably absent	Faintly present	Ultimate lines of moderate intensity	Faintly present	Of moderate intensity
Mn II...	Present but faint	Most lines faintly present; > η Leonis	Absent	Absent	Probably faintly present	Doubtful
Fe I....	Lines $\gtrless$7 on Burns's scale present	λ 4045 faintly present; a few other strong lines probably blended	Lines >6 on Burns's scale present	Lines $\lessgtr$3 on solar scale present	Lines >5 on Burns's scale present	Lines $\gtrless$ 3 on Burns's scale present
Fe II....	For behavior of λ 4233 see Table I	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
Ni I....	Absent	Absent	Faintly present	Possibly a trace	Probably absent	May contribute to faint blends
Ni II...	Fairly strong	Very strong	As in η Leonis	Of moderate intensity	Probably faintly present	Present but rather weak
Zn I....	Not observed; out of spectral range	Absent	See η Leonis	Probably faintly present; weaker than in sun	See η Leonis	See η Leonis
Sr II....	For behavior of λ 4215 see Table I	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
Y II....	Present but rather weak	As in η Leonis	About as in η Leonis	Very strong	Faintly present	Somewhat stronger than in α Lyrae

TABLE VI—*Continued*

	15 U Ma	α And	τ^9 Eri	φ Her	θ Aur	β Cr B
Cr I....	Well marked	Absent	Faintly present	Faintly present	Faintly present	Fairly strong
Cr II....	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
Mn I...	Strong	Faintly present	Possibly a trace	Intermediate in intensity	Rather weak	Moderately strong
Mn II...	Absent	Well marked	Probably a trace	Well marked	Almost all lines faintly present	Probably
Fe I....	Lines $\gtrless 2$ on solar scale present	Possibly a trace of λ 4045	A few of the strongest lines faintly present	Lines $\gtrless 5$ on Burns's scale present	A half-dozen of the strongest lines faintly present	Lines $\gtrless 2$ on solar scale present
Fe II....	Stronger than in Vega and γ Geminorum	See η Leonis	See η Leonis	See η Leonis	See η Leonis	Weaker than in 15 υ Majoris
Ni I....	May contribute to blends	Absent	Doubtful star line agrees in position with λ 4401	Probably faintly present	Absent	May contribute to blends
Ni II...	Probably contribute to blends	Faintly present	Absent	Faintly present	Probably present	May contribute to blends
Zn I....	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
Sr II....	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis	See η Leonis
Y II....	Strong	Possibly a trace	Faintly present	Strong	Faintly present	Probably faintly present

TABLE VI—*Continued*

	η Leo	υ Sgr	α Cyg	ϵ Aur	α Lyr	γ Gem
Zr II....	Probably a trace	Absent	Faintly present	Very strong	Faintly present	Probably slightly stronger than in α Lyrae
Ba II...	Absent	Absent	Absent	May be faintly present	Absent	Rather faint
La II...	Absent	Absent	Absent	Probably faintly present	Possibly a trace	Possibly a trace
Ce II....	Although there are a number of coincidences of stellar lines in A-type stars with strong laboratory lines of *Ce* II, plates of higher dispersion are needed to settle the presence or absence of this element.					
Eu II...	Absent	Absent	Absent	Absent?	Absent	Absent?

TABLE VI—*Continued*

	15 U Ma	α And	τ^9 Eri	φ Her	θ Aur	β Cr B
Zr II...	Moderately strong	Absent	Trace ?	All of strongest lines present	Probably a trace	Rather weak
Ba II...	Well marked	Absent	Doubtful contributor to blends	Faintly present	Probably contributes to blend	Probably contributes to blend
La II...	Definitely present; rather faint	Absent	Absent	Absent	Absent	Absent
Ce II....	....	....	....	....	....	....
Eu II...	Absent ?	Absent	Possibly present	Possibly present	Present?	Very strong

An examination of the behavior of the elements in such heterogeneous A0 stars as Vega, α Andromedae, τ^9 Eridani, θ Aurigae, and α^2 Canum Venaticorum shows how difficult it is to devise a satisfactory system of classification. No two of the foregoing spectra are at all similar, but even these six examples do not exhaust all the possibilities. To cite two other examples, the stars 21 Persei and BS 1732, both of types A0, have certain peculiarities quite different from any of the standard stars. In the spectrum of 21 Persei *Sr* II 4077 is strong and lines of *Mn* II and *Eu* II are outstanding. The general features of the spectrum of BS 1732 are similar to that of τ^9 Eridani, but *Si* III 4552—which is vanishingly weak in the few A0 stars in which it is observed at all—is actually stronger than in the B8 supergiant β Orionis. The spectrum of BS 1732 is variable and the *Si* III line probably has a variable intensity.

10. From the foregoing discussion it seems safe to conclude that there is some physical factor other than temperature and surface gravity concerned in the production of the spectra of the A stars and that the additional factor is probably variable effective abundance in a number of the elements observed, if not in all of them.

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SUMMARY

A qualitative description of the A-type spectra brighter than magnitude 5.5 is given. Definite evidence is found for the presence of a physical variable in addition to temperature and surface gravity. It seems very probable that this additional variable is the effective abundance of the elements.

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